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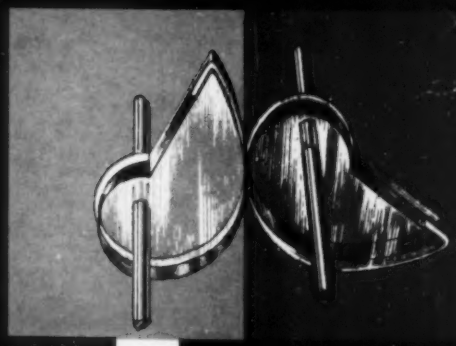
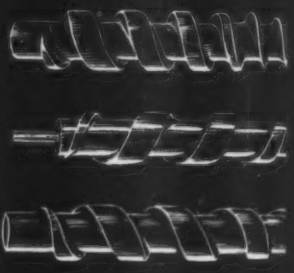
PRODUCT ENGINEERING

GRAW-HILL WEEKLY OF DESIGN, RESEARCH AND DEVELOPMENT • DECEMBER 14, 1959





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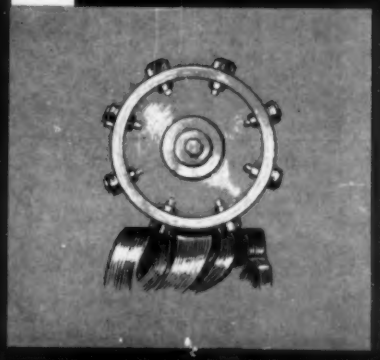

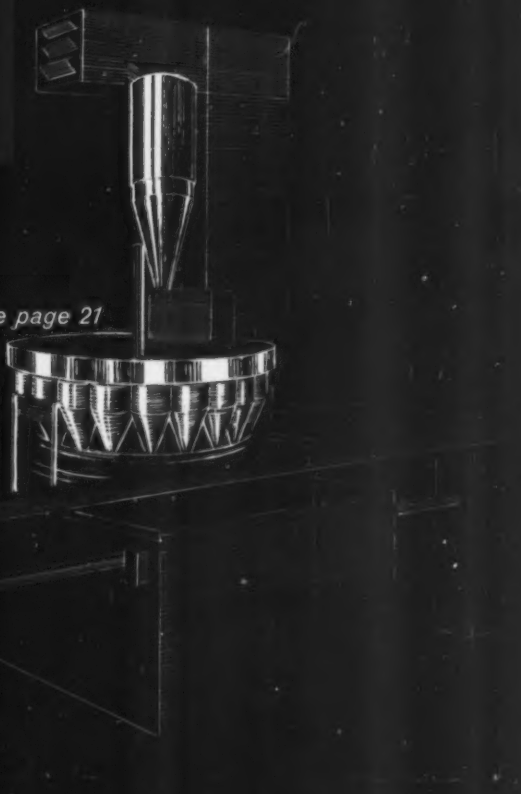

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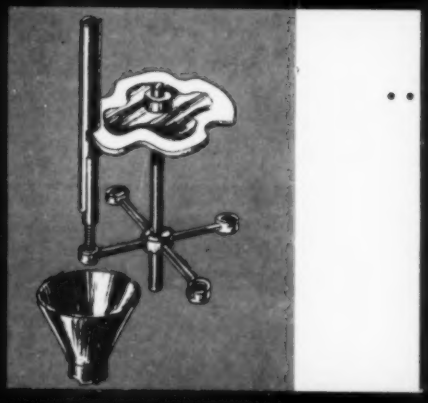

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Record breaking Atlas missile billows flame and vapor as she launches 4¼-ton satellite into orbit. Constructed of Type 301 Nickel Stainless Steel, Atlas is built by Convair (Astronautics) Division of General Dynamics Corporation. *U.S. Air Force photo*

130 tons of missile with a skin thinner than a window pane!

The Nickel Stainless Steel skin of the Atlas missile is actually about one-third as thick as the glass in your window.

And yet look what this skin does:

- It is the sole structural framework for Atlas—130 tons of dead weight at the moment of firing.
- It serves as the wall of the propellant tanks in Atlas' weight-saving design.
- It withstands the deep chill of liquid oxygen (−297°F) . . . the high heat of supersonic speed (400°F–600°F).

. . . And it is less than 1/25 of an inch thick!

No wonder they call stainless the space age metal. No wonder engineers turn more and more to Nickel Stainless Steel as temperatures rise . . . as speeds soar . . . as demands get more and more severe.

But Nickel Stainless Steel has many earthbound applications, too. Its strength and resistance to both corrosion and temperature extremes improves the performance and prolongs the life of many industrial products. And its attractive appearance provides still another reason for its popularity in products for the home.

What's your metal problem? Is it high or low temperatures? Corrosion, stress, fatigue or an unusual combination of factors? Write to us about it. Perhaps Nickel—or one of its alloys—can help you get it off the ground.

The International Nickel Company, Inc.
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NICKEL MAKES STEEL PERFORM BETTER LONGER

Does your product deserve an award?

Product Engineering is instituting the first of a series of

ANNUAL AWARDS FOR ACHIEVEMENT IN PRODUCT DEVELOPMENT

The purpose:
recognition for a job well done.

If you're proud of your development program and of the product that came out of it; if the engineering, design, manufacturing and marketing objectives were met uniquely and well; send for an entry blank and see if our distinguished group of judges agree. Judges will award as many citations as they feel are warranted, based on the excellence of the entries.

To be eligible for the first year's award, a development program must have introduced a product for sale between March 1, 1959, and February 29, 1960.

For an entry blank plus a copy of the rules, write "Awards" in the space marked Special Data on the Reader Service card bound in this issue, add your name and address and send it in. You'll have our answer by return mail.

Entries must be mailed by February 29, 1960

coming next week

the DESIGN issue for December 21

FEATURING:

- **Tap the reserve strength in metal parts**
  How to design beam sections that exceed their yield strength.

- **To design multi-variable experiments**
  Set up a statistically planned experiment to get max information from a min of tests.

- **Cast epoxy models**
  How to produce prototypes that convert new product ideas into actual parts or assemblies.

- **Predict induction-motor performance**
  Pre-calculated curves to help establish whether your motor can handle an unusual duty cycle.

- **Cheaper way to weld tubes**
  Fusing an insert ring into the critical area is most economical in the long run.

- **29 Ways to fasten springs**
  Four pages of ingenious attachments for extension, compression and torsion springs.

Product Engineering

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Product Engineering ..... SIDELIGHTS

R and D RESEARCH and DEVELOPMENT news issue

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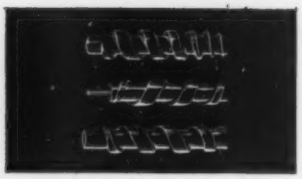

● **The ingenious mechanisms on our cover** (and p 21) are finally making an impression on the art world. Jean Tinguely, a Parisian artist, has designed a machine to paint pictures. Arms holding tubes of paint and crayons slash and splash on paper. They are driven by small electric motors controlled by electric switches —and anybody can play. We're told that despite the unpredictability of the motions, a dainty lady at the switches makes a dainty abstract; a muscular bruiser turns out more robust pictures. The inventer claims the "Metamatics" are happy machines because they lack discipline. Mr Tinguely may soon be a victim of technological unemployment.

● **More students abandon engineering** than any other college course. This term, Cornell University's Division of Unclassified Students received 67 flunked-out engineers and only 24 from other courses of study, which is a pretty sad commentary on highschool guidance counselors and their engineer-fashionable advice. The division is a hopeful experiment in student salvage. Instead of having to leave school, a student whose grades are bad but not hopeless may enter the division. He takes any course Cornell offers but must average 77 or better while "finding himself." About 60% do.

● **Statistics never seemed as cold to us** as they evidently do to most nontechnical people—that is, until we saw the results of a recent survey of research in solid-state physics. The surveyors attacked the problem in a straight-forward way by counting up the number of papers published in each sub-field, and then they charted the papers on a graph (1 in. = 200 papers). That's what stopped us—a year's painstaking work reduced to 1/200 of an inch by a callow PhD candidate. Suddenly census takers and salary surveyors and TV ratings became evil symbols of our lost individuality, of scientific inhumanity under the guise of Truth. The moment passed, perspective restored, but we'll never again feel quite so superior to our wife's distaste for the voting machine.

ABP December 14, 1959

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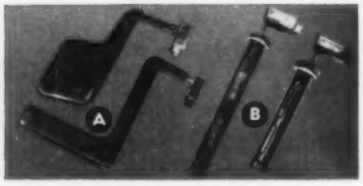
How to select cast-in immersion Heaters for Metal Melting Applications

Here is condensed information to help you get the most economical electric heater for any design problem where melting soft metals is a factor.

General Electric cast-in immersion heaters can be applied to virtually any process machine which uses soft metals in a molten state.

Two factors generally determine which General Electric cast-in immersion heaters should be used. They are: the physical characteristics of the machine or pot, and the temperature required.



"Over-the-side" immersion heaters (a), as their name implies, are merely suspended in the pot or crucible with their effective heating portions immersed directly in the metal. Installed in this manner, these heaters can be easily shifted to vary the heat distribution as required. Furthermore, these heaters can be added or replaced without shutting down the bath.

"Through-the-side" immersion heaters (b) are designed for relatively permanent mounting on the side of the crucible or pot by means of a gasketed flange header. This type of heater is best suited to smaller pots because of its relatively small radiating surface.

To figure the amount of heat required for your application:

1. Determine weight in pounds of the metal to be heated. (Volume of the pot in cubic feet x weight of metal in pounds per cubic foot from Table II.)

2. Determine operating temperature of metal bath from Table II.

3. Using the data obtained in Steps 1 and 2 above, read kilowatt hours from Table I.

4. Divide the answer obtained in Step 3 by the hours allowed for heat-up. You now know how many kilowatts of heat are required for your installation.

For complete information on sizes and ratings of General Electric heaters, call your General Electric Apparatus Sales Office or send coupon below.

DELIVERY TODAY: Popular sizes of General Electric heaters are available today from General Electric stocks near your plant.

SPECIAL SAMPLES: Your General Electric sales engineer can advise you on special heating problems. If special heaters are required, he will provide samples.

PROMPT SHIPMENT: General Electric's new Industrial Heating plant at Shelbyville, Indiana, is now geared to give excellent shipping dates on heaters for your production needs. Just call your nearest General Electric Apparatus Sales Office and tell us your requirements. General Electric Company, Schenectady 5, New York.

TABLE II METAL MELTING DATA

Metal	Wt in Lb per Cu Ft	Melting Temperature in Deg F	Heat Required to Melt 1 Lb		Watt-hours Required to Heat 1 Lb 1 F from Melting Temp.	Usual Operating Temp. in Deg F	Watt-hours Required to Bring 1 Lb to Working Temp.
			Btu	Watt-hours			
Lead	710	620	28	8.3	0.0098	725	9.2
Tin	455	450	47.5	14.0	.0187	600	16.7
Solder (1 part tin, 1 part lead)	555	400	33	9.6	.0152	650	13.8
Solder (2 parts tin, 1 part lead)	520	365	38.8	11.4	.0171	520	13

TABLE I TO DETERMINE KW HOURS

Weight in Lb	Solder (2 Parts Tin, 1 Part Lead)			Solder (1 Part Tin, 1 Part Lead)			Tin			Lead		
	470°F	520°F	570°F	600°F	650°F	700°F	550°F	600°F	650°F	700°F	725°F	750°F
	KW Hours			KW Hours			KW Hours			KW Hours		
100	2.3	2.4	2.5	2.3	2.4	2.5	2.7	2.8	2.9	2.5	2.6	2.7
500	9.3	10.0	10.7	9.6	10.1	10.7	11.5	12.0	12.5	4.7	5.2	5.7
1,000	18.3	19.3	20.3	18.6	19.7	20.8	22.5	23.5	24.5	18.1	19.1	20.1
1,500	25.5	27.0	28.5	33.7	35.2	36.7	32.0	33.5	35.0	23.9	25.4	26.9
2,000	38.0	40.2	42.5	46.5	48.5	50.5	47.0	49.0	51.0	33.0	35.0	37.0
2,500	46.0	48.0	50.2	54.0	57.0	59.5	56.0	58.5	71.0	44.3	46.8	49.3
3,000	52.0	56.0	60.3	61.3	64.6	67.8	66.0	70.0	74.0	50.0	53.0	56.0
3,500	60.0	64.0	68.5	68.7	72.4	77.0	75.0	79.0	83.0	56.0	59.5	63.5
4,000	67.0	71.5	76.5	76.5	80.7	85.0	84.0	89.5	94.5	62.0	66.5	70.5
4,500	75.0	81.0	87.5	83.5	89.0	95.0	94.0	100.0	105.0	68.0	73.0	78.0

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Reader To Editor . . .

Sharpener to Cut Parallel

To the Editor:

In your "Why Don't They R & D" column (Sep 21, p 47) Mr Brikowski asks for a pencil sharpener to cut parallel to, rather than around, the lead. In the late 1920s my parents bought (in Germany) a sharpener which removed wood and "lead" parallel to the pencil axis. (I bought a rotary one which is more efficient.) Principle of the sharpener was: A pressed-steel disk contained, integrally, six radial cutting edges. The disk was rotated by a hand crank around its center, the axis of rotation being horizontal. The pencil was held slightly off the vertical in a spring-loaded holder which was rotated through a simple set of right-angle reduction gearing. With each one-sixth revolution of the disk, some material was removed from the pencil until it had completely assumed the shape of the conical form into which it was gradually forced as sharpening proceeded. Once pencil and form were identical, no further material was removed and the process stopped. A device was even incorporated which allowed to preset the sharpener to various "pointednesses." Soft, colored pencils were to be sharpened to a blunt point only.—W. H. OETTINGER
San Diego, Calif

• Our thanks to Messrs Ringer, E E Aylor, M F Sullivan, C E Shaeff, and H Merz, who contributed suggestions.—Ed.

Precision Twine

To the Editor:

In regard to the ad on the back cover of your Nov 2 issue—precision-built leather straps are no longer a problem with us, but would you kindly let us know where we can obtain several hun-

dred feet of precision designed bailing twine, such as the type one might use to hold up cranks on fine racing cars.
—CHARLES O. THEISEN
Cosmotron Department
Brookhaven National Laboratory

• The advertising copy ran, "A fine racing car must be *precision-designed* and *precision-built* . . . etc."

Salt River Valley Water Users Association,
Phoenix, Arizona

Saves $699.00 per pump...

by using ground and polished

fatigue-proof STEEL BARS **e.t.d.**

made by elevated temperature drawing process

The men who operate the "Salt River" project have the job of supplying water to 240,000 acres of land in Arizona, where the Gila River joins the Salt River. The Association maintains some 250 deep well pumps to help supply the required water.

Richard Juetten, Supervisor of Salt River's Pump Division, reports that the use of La Salle FATIGUE-PROOF steel bars has permitted a saving of $699.00 per pump . . . a potential saving of $174,750 when applied to the 250 pumps now in operation.

Mr. Juetten's report follows:

"I have figured our direct saving realized by using La Salle FATIGUE-PROOF steel bars in place of standard C-1045 steel shaft in our deep well turbine pumps.

"FATIGUE-PROOF enables us to use bars only $1\frac{11}{16}$" in diameter . . . instead of $2\frac{3}{16}$" diameter shafts which were necessary when we used C-1045 . . . and this despite higher horsepower, more weight, and additional pump bowl assemblies.

"Here are comparative costs per 10-foot section (of a 300-foot pump shaft):"

using C-1045		using FATIGUE-PROOF	
10′ x 2-3/16″ dia. shaft	$28.30	10′ x 1-11/16″ dia. FATIGUE-PROOF	$22.59
3½″ shaft housing	26.30	3″ shaft housing	19.80
2 bearings, 3½″ x 2-3/16″	21.72	2 bearings, 3″ x 1-11/16″	13.46
Shaft coupling	5.16	Shaft coupling	2.34
TOTAL cost	$81.48	TOTAL cost	$58.19
Cost per foot	$ 8.15	Cost per foot reduced to	$ 5.82

RESULT: A saving of $2.33 per foot . . . or $699.00 when applied to a 300-foot pump setting. And this doesn't take into consideration reduced power consumption.

FATIGUE-PROOF permits smaller shaft here
FATIGUE-PROOF permits smaller bearing here
FATIGUE-PROOF permits smaller shaft housing here
FATIGUE-PROOF permits smaller shaft coupling here

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DEVELOPMENTS TO WATCH...

American

Scandium metal in precision-cast shapes . . .

. . . is now being supplied in developmental quantities by St. Eloi Corp, Cincinnati 44.

Though classed as a "rare" element, scandium is believed to be about twice as abundant as zirconium, and present in amounts comparable to boron and beryllium. It's generally found in association with the rare earths and resembles them chemically. Physically, it stands between aluminum and titanium in many of its properties. Its density is almost exactly midway between the two, while its melting point (about 2800 F) is quite close to that of titanium.

Until Wright Air Development Center turned the spotlight of an R & D program on it (*PE—Jan* 19, *p* 13), scandium was almost an unknown metal—available only on a laboratory basis and at extremely high cost. It's still far from inexpensive; but its developmental price of $50/gm for distilled metal is comparable to that for other "new" elements.

Paper that elongates in all directions . . .

. . . promises improved insulating and laminating materials. It's an outgrowth of the "stretchable," extensible paper, first announced two years ago by Clupak Inc (*PE—Jan* 6 '58, *p* 34).

This is not a creped paper; its fibers are compressed and interlocked during processing so the material will expand, rather than break, under tension. This expansion—on the order of 5 to 25%, though it can go even higher—gives a considerable spread between yield and tensile strength.

Particular advantage of the new type is that this expansion is almost even in all directions, rather than predominantly in one direction, as was true of the type first introduced. This makes it a much more textile-like material and offers a considerable advantage for such applications as those noted above. It is possible, too, to apply the process to other fibers—among them asbestos, providing a nonflaking, flexible, high-temperature material.

This "isotropic paper is not yet in production: but information may be obtained from Clupak Inc, 530 Fifth Ave, New York.

Plastics picture for 1960 . . .

. . . will show new names entering the lists of commercial materials. Dow, Texas Eastman and Esso (Humble Oil) will join Hercules and AviSun as polypropylene producers (*PE—Oct* 26, *p* 38), with at least two to follow. There will be at least one addition to the list of linear polyethylene producers as well, and expansions in capacity for others.

Such long-heralded materials as Delrin (acetal resin) should at last become available; and elastic urethane fibers should be in commercial production.

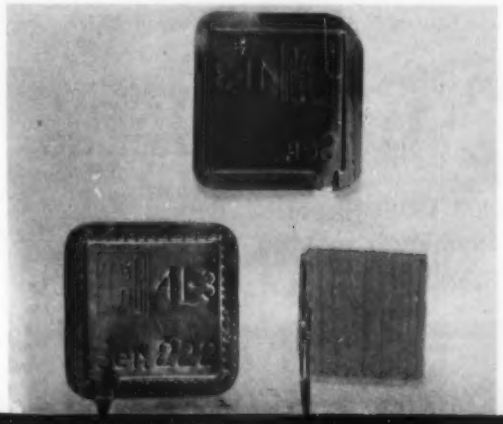
Plastics, both old and new, are expected to boom, with total consumption reaching 5 to 6 billion lb. That really puts them in the tonnage class. It's close to the combined output of copper and aluminum.

Cars alone could take almost 10% of this. Current use runs about 20 lb/car (*PE—July* 6, *p* 35). But, says W. P. Gobeille of American Motors, if the standard car used plastics as the Volkswagen does, the total would exceed 40 lb; and he feels 60 lb/car is by no means an unreasonable figure for the near future.

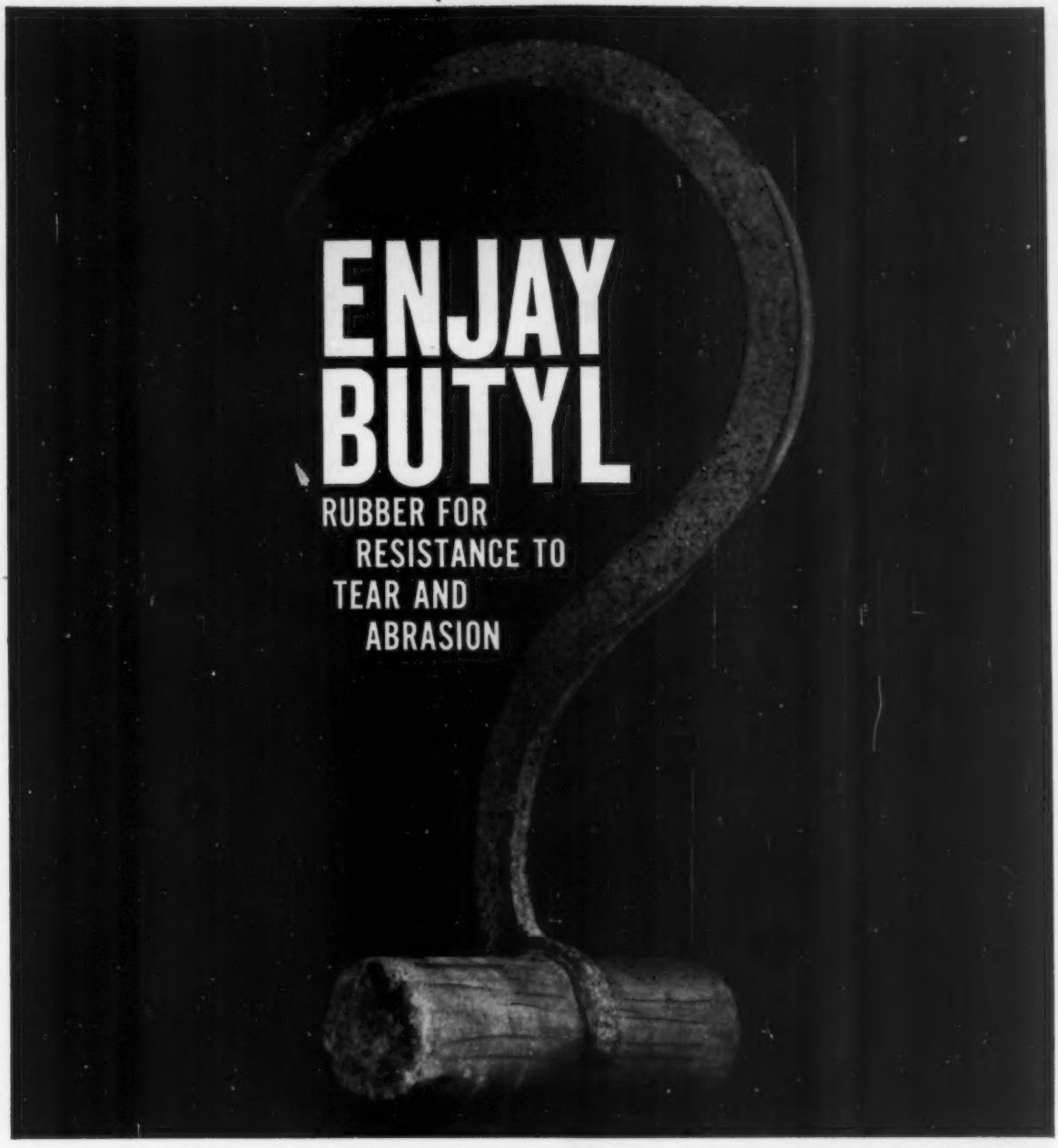
Surface-temperature element . . .

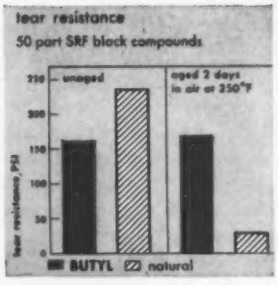
. . . of unusually simple design is said to have an accuracy close to 0.1% over its temperature range.

Engineers at Convair Instruments, San Diego 10, Calif, designed it for a missile-logging system, but the company believes it has commercial potential, and is ready to make it in two standard ranges, 0 to 200 F and 0 to 400 F (resistance change: 500 to 600 ohms) as well as special types on request.—ARG



Temperature-sensing device consists of flat stainless steel box enclosing a rhodium-platinum-palladium wire grid.





Enjay Butyl offers the highest aged tear strength of any rubber. Even after long exposure to heat, oxygen and ozone, Butyl retains nearly all its original tear and flex resistance...keeps its stretch without tearing. And Butyl's inherent toughness offers rugged resistance to abrasive wear. Butyl is the preferred rubber and proven superior in such applications as conveyor belts, hoses, heavy-duty off-the-road truck tires, and other mechanical goods.

Butyl also offers...outstanding resistance to chemicals, weathering, sunlight, heat, and electricity...superior damping qualities...unmatched electrical properties and impermeability to gases and moisture.

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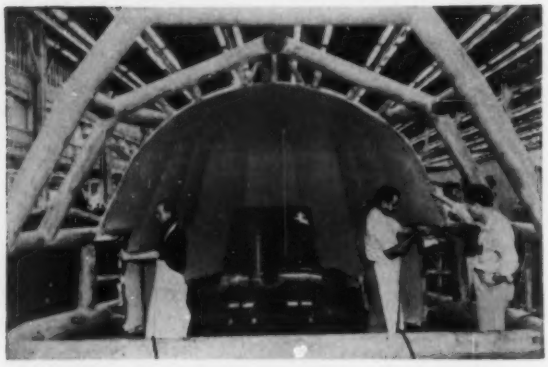
1 The tube is a reinforced epoxy housing that protects:
(a) a communications antenna *(b) a radio transmitter*
(c) miniature rockets

2 Its ignition coil, completely embedded in epoxy, is safe from:
(a) moisture *(b) temperature extremes*
(c) shock

Can you pass this test on Epoxy Plastics?

(You'll discover more of their potential as design materials)



3 This airplane construction tool of epoxy-glass cloth:
(a) checks dimensions of fuselage *(b) supports the frame*
(c) is part of the mock-up

4 This tough, strong, pleasure boat hull is made from:
(a) laminated epoxy and glass fiber *(b) epoxy-coated wood*
(c) epoxy-coated metal

5 Their trip to school is safer in a bus with:
(a) epoxy-glass fiber seat frames *(b) an epoxy-sand coated floor*
(c) epoxy-embedded electrical parts

ANSWERS ... *to tomorrow's needs are coming from adaptable BAKELITE epoxy plastics.*

1. Check (a). It minimizes weather and electrical interference along our defense communications lines.
2. Pick (a), (b), and (c) – and epoxy won't harm delicate windings, either.
3. (a) Checks dimensions – it's lightweight and extremely accurate.
4. (a) Epoxy-glass laminate – but epoxy coatings are great on other hulls.
5. (b) They won't slip on this floor's tough, gritty surface.

If you have questions – about designing with plastics for function, serviceability, economy and appearance – please ask us. We'll be glad to answer on the practical design and engineering uses of vinyls, epoxies, phenolics, styrenes, and polyethylenes. Just write or call any of our offices or write Dept. LX-03D, Union Carbide Plastics Company, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. *In Canada:* Union Carbide Canada Limited, Toronto 7.

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DEVELOPMENTS TO WATCH...

World-wide

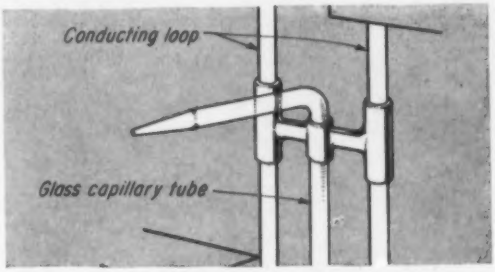
An oscillograph that writes with a jet of liquid . . .

. . . instead of a pen or stylus, is now being made in Germany. It handles frequencies to 1,000 cps, and produces a record that can be read immediately.

As indicated by the diagram, the recording mechanism resembles that of a light-beam recording oscillograph—but a jet nozzle replaces the pen arm. The nozzle is fastened to a conducting loop located between poles of a permanent magnet, as in a mirror oscillograph, so the nozzle will follow the movements of the loop as it deflects in the magnetic field.

Amplifiers compensate for the relatively low current sensitivity of the galvanometer (about 300 ma is required for full deflection) and assure linear reproduction even with very large deflection angles.

An electrical vibrator pump feeds liquid to the nozzle, permitting variations in liquid pressure from 210 to 640 psi and making it possible to adjust the liquid quantity to the recording speed. A blotting roller is provided to take up any excess. In addition, the pump is coupled to the paper drive so liquid squirts only when the paper is moving.



Nozzle opening of Siemens oscillograph is only 10 microns (0.0004 in.) dia.; produces a pen-like tracing.

Originally designed in Sweden, the unit is now being made by Siemens of West Ger. (Note: For more on recorder design, see p. 14.)

A liquid- level probe so sensitive . . .

. . . it can be used in demineralized water, not normally considered an electrical conductor, has been developed by UK Atomic Energy Authority.

As the UKAEA describes one setup, the device consists of a spring-loaded contact plate which serves as the datum (reference level) and an electrical probe consisting of a platinum point suspended from a stainless steel drum. This is operated by a thyratron-controlled split-field dc motor. A level indicator completes the system.

In operation, a change-over switch energizes the first field of the motor, turning the drum and lowering the probe until it touches the liquid. This contact completes a circuit, firing the thyratron and energizing the second field of the motor. Since the second field has twice the current in the first, it overrides the first field and turns the drum in the opposite direction, raising the probe and breaking the contact. UKAEA has patented the device and plans to license it for manufacture.

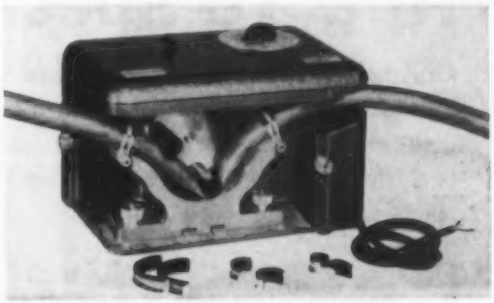
Pumping by pinch effect . . .

. . . is the aim of this British device, designed to substitute for conventional pumps.

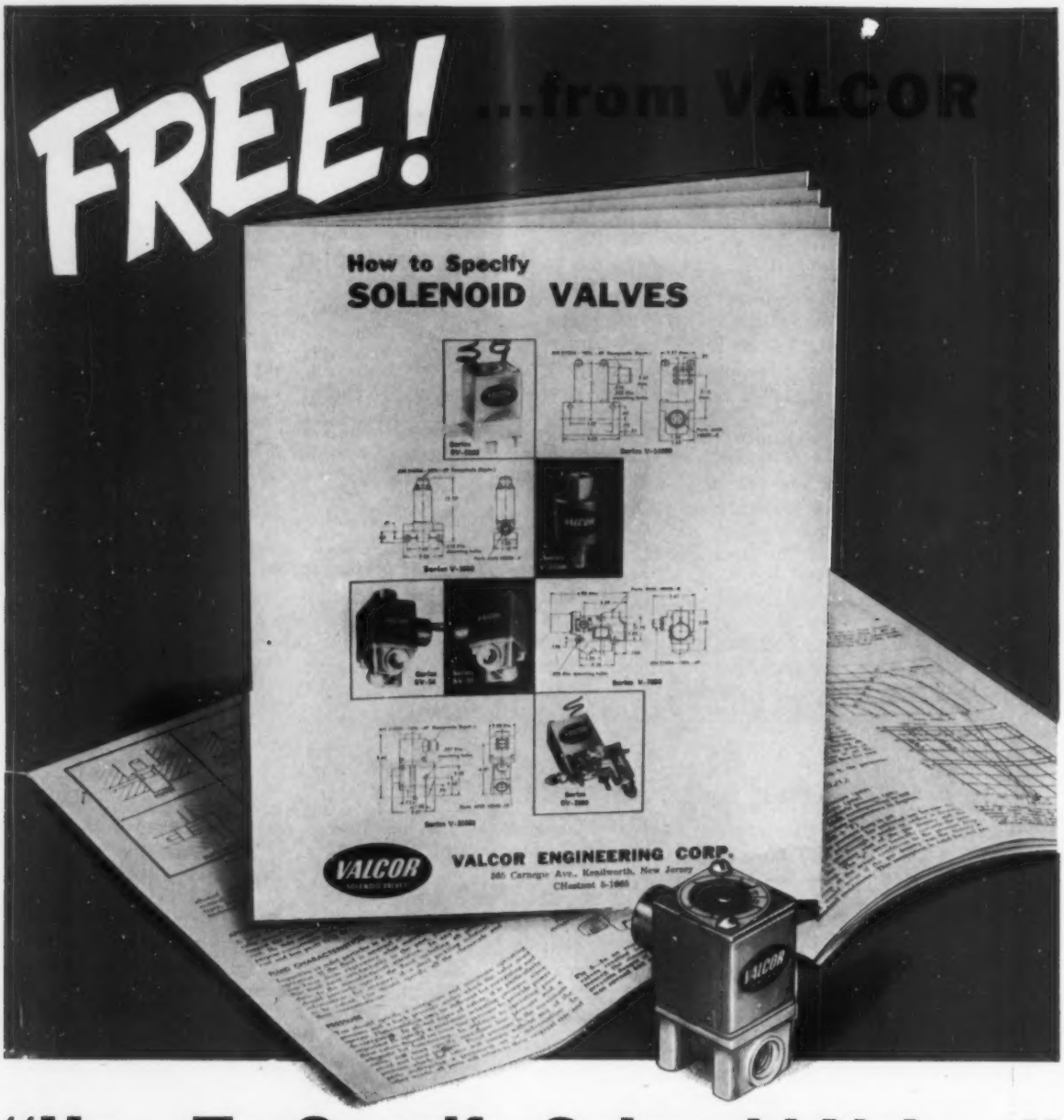
It consists of a rotor with three rollers that squeeze the pipe against a curved track, driving the fluid ahead as it is sucked in from behind. The suction effect, says the designer, makes it possible to generate and hold a "considerable degree" of vacuum (down to at least 1mm Hg), and to use the device as an oil-free compressor. Other applications: pumping of powders and transfer of toxic gases.

Watson-Marlow Air Pump Co, the manufacturer, says it will operate on a standard single-phase, ac, 1/10-hp motor at 230/250 v, and has also designed an air-driven unit to go with it.

It's not yet marketed in the US; but Watson-Marlow estimates the cost at about $250. —ARG



Pinch-pump with triangular roller system and gently-curved track, moves liquids, powders and gases. Pipe clips are molded nylon with neoprene sheaths. Rollers are molybdenum sulfide-filled nylon.



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DEVELOPMENTS TO WATCH...

Washington

New patent regulations for NASA . . .

seem assured. The NASA (National Aeronautics and Space Administration) recently proposed an amendment to its present restrictive patent policy, that meets much of industry's complaint. Industry wants the agency to follow the same procedure used by the Dept of Defense and other government agencies. Under this setup, the government doesn't take title to inventions but uses them royalty-free.

When Congress set up the space agency, it laid down patent rules much like those used by the Atomic Energy Commission. For research and development contracts, NASA now takes title to all inventions. In some cases, NASA can waive its patent ownership, but it is an involved process.

Under the new proposal the agency would have temporary option to take title to inventions that result from R & D contracts. Whether or not the government does take patent titles will be determined when the contract is written.

The proposal to liberalize NASA's patent policy came at hearings held by the patent subcommittee of the House Astronautics and Space Patent Subcommittee Dec 1-5.

The House hearings on the matter were followed by similar hearings by the Senate Small Business Monopoly Subcommittee.

Before both congressional bodies, industry spokesmen argued for a liberalization of the NASA patent rules. Observers look for Congress to rewrite the regulations early next session.

More defense money for small business . . .

has been ordered by the Pentagon. The Dept of Defense is making it mandatory that on contracts in excess of $1 million, special efforts be made to use small business firms if subcontracting work is needed. Some 200 to 300 major defense contractors have been doing so voluntarily for some time.

This voluntary "Defense Small Business Subcontracting Program" by over 200 contractors during the first six months of 1959 resulted in some 18.2%—$1.6 billion—of their total defense dollar receipts going to small-business subcontractors, the Dept of Defense says.

The new regulation, slated to go into effect by the end of the year, will extend this practice to an estimated 300 to 400 more contractors.

Contracting companies will have to maintain records showing whether subcontractors qualify as a small business or not, and what procedures have been adopted to comply with all the government regulations.

Where a subcontractor gets a chunk of business totaling over $1 million from a prime contractor, it must also comply with the regulation if part of the work is further subcontracted.

There is some doubt as to how much more money will be channeled to small companies, since a large number of contract awards over $1 million require no subcontracting.

The Pentagon will keep closer tabs on its contracts to insure that the new regulation—slated to go into effect by the end of the year—is being obeyed. Specifically the regulation requires that small business firms have "an equitable opportunity to compete for subcontracts, particularly by arranging solicitations, specifications and delivery schedules so as to facilitate small business participation."

Fiscal 1961 defense budget approved . . .

finally by the Administration. Details will be kept secret until next month when the budget goes to Congress. But here is the general picture from word that has leaked out.

The over-all budget will stay within the $41-billion ceiling imposed by the White House. To do this, however, means a juggling of projects—some speed-ups, but mainly stretching out programs.

Slated to be cut down are such programs as production of Convair's B-58 bomber, Boeing's Bomarc anti-aircraft missile, IBM's SAGE air defense computer system, and naval anti-aircraft missiles, according to insiders.

It will also mean a sharp cutback in work on North American Aviation's B-70 bomber. Unofficial reports from the Air Force claim that only some $75 million will be spent on the project in fiscal 1961. Previously, the service had planned to spend around $300 million on the B-70 next fiscal year. B-70 was to use the cancelled GE J93-5 engine.

Due for speed-ups are the Air Force's Atlas and Minuteman ICBMs. But that is about all that will get any major boost in spending next year. Other military projects will be kept at or near their present developmental pace—including Navy's Polaris missile system.

WHAT'S HAPPENING IN... Science

New light on the effects of light

The "first simple physical measurement for predicting the performance of light stabilizers for plastics," and new routes to light stabilization were reported by a Tennessee Eastman Co research team to a local-section SPE meeting last week.

The measuring technique is an application of Nuclear Magnetic Resonance, familiarly known as NMR (*PE–Jan 26, p 12*). The T-E researchers report that, in at least two families of stabilizers (the salicylates and benzophenones), the negative shift in nuclear resonance of the molecule is directly related to its stabilizing effectiveness; and, they believe, it will be possible to develop a stabilizer index on the basis of this characteristic.

As to new stabilizing compounds, the TE researchers described two that apparently act quite differently from conventional types.

Most stabilizers now in use, they point out, are the radiation-absorbing type; but recently a nonabsorbing type, effective at least in polyvinyl chloride resins, has been found. This compound, hexamethyl-phosphoric triamide, in 2% concentration, can apparently protect the plastic from light damage over long periods of time. Another nonabsorber, a dinitrophenol, seems to have a similar effect in protecting rubber from gamma radiation.

Guide lines for recorder research

Jets that write with a pencil-thin line (p 11) are only one of a score of approaches to the problems of recorder development and application.

As George Keinath of National Bureau of Standards points out, a recording mechanism is basically a 3-component system: a reservoir of fluid or an energy source, a marking point positioned by the measuring element, and a recording surface.

For each of these, there are at least half a dozen alternatives.

The "fluid" may be a conventional ink or lead, a jet of gas, an electrostatic system, a carbon system, a beam of light, smoke, or heat that traces a line on a coated surface.

The marking "point" may be a pen, pencil, metal stylus, capillary tube nozzle, electrical sparking device, or ultrasonic transducer.

The paper may be waxed or transparent, plastic or chemical coated; or it may not be paper at all, but metal foil or plastic film.

The chart itself may be a cylindrical segment, a continuous shape, a flat disk, a board, or a drum.

The permutations and combinations are almost infinite; and systems using almost every one are or have been on the market.

But there is still room, as Keinath's summary shows, for simpler, surer, faster mechanisms.

His summary of recorder types and mechanisms is being made available in printed form through the Government Printing Office as NBS Circular 601. (Price: 30¢)

Ultrasonics: what's the key?

The number of proposed and lab-tested applications for ultrasonics is rapidly approaching the three-score-and-ten stage; yet only a few—notably flaw-detection, small-parts cleaning, brazing and soldering—are on anything like a large-scale commercial basis.

What's holding up the parade?

A recent report from Canada's National Research Council puts the answer clearly:

"Ultrasonics will do a great many things, but many of these things are done satisfactorily by more economical methods. Ultrasonic units are quite expensive, prices running from $150 for small laboratory units up to many thousands of dollars for large-scale industrial units. In certain special applications, however, ultrasonics is the best, the only effective method of doing the job. Ultrasonics is an unusual method, suitable for handling the unusual problem."

Taking a specific example, ultrasonic machining, the Canadian report notes that it does permit working of many materials that are difficult to cut by ordinary methods. But the cutting rate is very slow, and the initial equipment cost very high.

As to electroplating, the report says: "Ultrasonic cavitation causes turbulence at the electrode surface which reduces hydrogen overvoltage, prevents gas polarization and reduces the electrolyte concentration gradients. There is not yet general agreement as to its applicability, but it is an application of ultrasonics worth investigating."

Similar findings have come from US labs—in respect to food-thawing, (*PE–July 13, p 13*) and facsimile recording (see above)

briefs . . .

Instrumentation for analysis is the subject matter of a new publication being offered by Baird-Atomic Inc, Cambridge, Mass. It will be issued quarterly, will cover optical emission spectroscopy, radiation detection, and the like.

Time-indicating tapes that tell when materials have received a specified amount of heating for a specified period of time are being developed by several companies. First application: to indicate sterilization of foods and drugs, but others are on the way.

One such tape, announced earlier this year, has a colorless chemical striping which turns brown after heating at a specified temperature for a specified time. Another, recently introduced by Professional Tape Co, Riverside, Ill, is imprinted with a colorless ink that turns black and spells out its message. Since the message can be read through glass, it provides a permanent "sterile" label. Other markings can, of course, be applied. —ARG

WHAT'S HAPPENING IN... Materials

New angle on thermal fatigue

Heating to temperatures well below the usual tempering range can markedly reduce the stress-rupture life of martensitic steel, an NASA study indicates. Lewis Research Center metallurgists have been studying the effects of thermal cycling on stress-rupture life of heat-resistant alloys, and now report that behavior of a martensitic steel subjected to thermal cycling is markedly different from that of the "superalloys" previously studied.

Among their findings:

- There is a critical or transition temperature for martensitic steel above which cycles-to-failure endurance is reduced by as much as a factor of 10. No such marked transition point was found for the superalloys. For the martensitic steel tested (Crucible 422), this critical point was 1200 F. Samples cycled from 200 to just below 1100 F stood at least 20,000 cycles. Samples cycled to 1200 F lost half their stress-rupture life in 800 cycles, and failed in less than 2000.
- Prior cycling above this point will seriously affect performance of samples later cycled below it.
- Even thermal cycling to a maximum temperature of 1150 F, which is below the normal tempering temperature used in heat-treating steel, is sufficient to lower the stress-rupture life markedly after 1350 cycles.

Metals to protect hot metal

Can electrodeposited metal coatings protect columbium, molybdenum, titanium, tungsten, tantalum, and vanadium from corrosion and oxidation at elevated temperatures? A recent Defense Metals Information Center report indicates it's possible—but surprisingly little has been done along these lines so far. Only for titanium and molybdenum is there anything like an array of procedures, or even a goodly number of literature references.

For columbium, two procedures are described, one for depositing nickel or iron, the other apparently specifically for iron.

For tungsten and tantalum, there are three nickel-plating systems, two of which (including the one mentioned for columbium) can be adjusted for depositing other metals—iron, chromium, tin, or copper. In addition, there are two gold-plating systems.

A literature search showed very little in the way of specific procedures for tantalum, says DMIC.

Available information on electroplating vanadium is limited, but some success in depositing nickel on vanadium-base alloys is reported.

Copies of the report, which includes tabular presentations for titanium and molybdenum, are available from DMIC.

Plastics urged to stop, look, and listen

A slowdown in commercial introduction of new plastic families is being recommended by an increasing number of industry leaders.

The reason: suppliers, fabricators, and users alike are having a hard time keeping up with those already available.

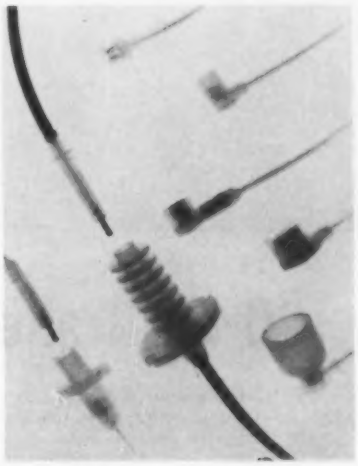
The past few years have seen the introduction of linear polyethylene, polypropylene, polycarbonates, acitol resins, and many special-purpose compounds; and no two can be processed or applied in exactly the same way.

Now, these experts say, it's time to call a halt while technical data and fabrication information are collected and accumulated, and familiarity with those already available is built up.

If this is not done, they warn, there's likely to be trouble—in the product and on the production line. Attempts at fabrication and application based on insufficient technical information can give the new materials an undeserved reputation for being "difficult" to handle and may unnecessarily restrict design to relatively simple parts for noncritical applications.

brief . . .

Graphite fiber laminates offering high resistance to heat (*PE—June 22, p 35*) are now available for evaluation from Continental-Diamond Fibre Corp. These are phenolic laminates, incorporating the "flexible" graphitized fibers announced by National Carbon earlier this year (*PE—May 4, p 7*). CDF says they have remarkable flame resistance. In tests with a 5000-F flame, a ¼-in.-thick sample showed a burn-through rate of less than 0.0005 in./sec, compared with 0.0017 in./sec for high-silica glass and 0.004 in./sec for felted asbestos laminates. First samples will go to missile-program contractors, but 6-by-6 in. laminates and 3-in.-dia moldings should be available soon. —ARG



Flame resistance of new high-density (linear) polyethylene won UL approval for these connectors, says W R Grace & Co, supplier of the material. Alden Products now supplies a full line of these molded electrical components. (Note: for information on other materials that resist flame, see *PE—Aug 3, p 38*).

80-ton trailer hauls 5 times its own weight!

LeTourneau-Westinghouse designed this bottom-dump hauling unit to carry the greatest payload with the least possible empty weight. The trailer weighs only 15½ tons but will haul a whopping load of 80 tons or more. This gives it an extremely high ratio of payload to weight and makes the unit most economical on fuel, tires and other operating costs. The trailer differs radically in design from conventional units. Much of the body is built from USS MAN-TEN Brand High Strength Steel to save weight. Sides are corrugated ⅛-inch MAN-TEN having the equivalent bridge strength of inch carbon steel. Wear plates on the front and back slopes are 3/16-inch MAN-TEN to assure high resistance to abrasion and impact. The highly stressed rear-axle assembly was built with USS

Mr. Big hauls as much coal as 1½ railroad cars but weighs less than most 50-ton capacity trucks. USS Special Steels make the difference.

. . . built from USS MAN-TEN and USS "T-1" Steels

"T-1" Constructional Alloy Steel which has an extra high yield strength of 100,000 psi.

This combination produced a tough wear-resisting unit that would take the beatings from coal or rock. Both steels saved weight and resulted in a payload increase of 10 tons over conventional construction. In 21,000 miles of operation, no sign of structural weakness or body fault has been observed.

Design equipment with USS Special Steels . . . MAN-TEN for strength with economy, COR-TEN for strength with superior corrosion resistance, TRI-TEN for strength with toughness and "T-1" for extra high strength and impact abrasion resistance. For more information, write to United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

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The best surface on the toughest base . . . made and controlled by Du Pont from start to finish.

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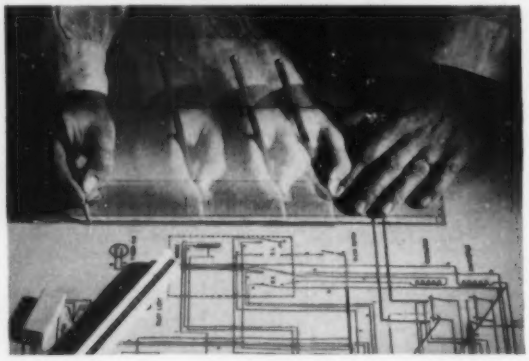
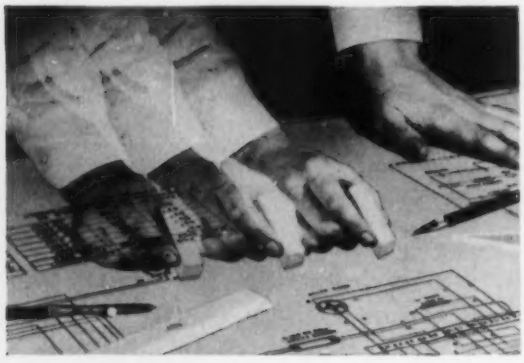


2 CRONAFLEX Drafting Film erases easily, without ghosting, yet there is less smudging. It comes matted one or two sides, and is available in either rolls or sheets.



3 CRONAFLEX Drafting Film is .004" thick, which has been found to be ideal for drafting. Its rugged CRONAR* polyester film base will take repeated handling and countless trips through your reproduction machine and to and from your file drawer without cracking or becoming brittle. It lies flat, holds size, is flexible and impervious to moisture.

CRONAFLEX Drafting Film is the first product of its kind which is made in its entirety by a single manufacturer. The benefits can be summed up in two words: quality control. We control the manufacture of both base and surface, and we control the method by which they are made into the best drafting film you can buy.

This means that every sheet of CRONAFLEX Drafting Film has the same excellent pencil acceptance, the same erasability, the superb matte surface, the .004" thickness which has been found ideal for drafting and filing.

If drawings are made anywhere in your operation, you can use CRONAFLEX Drafting Film to great advantage. CRONAFLEX Drafting Film joins the widely acclaimed CRONAFLEX line of films: Direct Positive, Contact and Projection. You can go from original drawing to final reproduction with the same product line on the same strong base. For more information write: E. I. du Pont de Nemours & Co. (Inc.), Photo Products Department, Wilmington 98, Delaware. In Canada: Du Pont of Canada Limited, Toronto.

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**Du Pont's trademark for its polyester photographic film base.*

Product Engineering HORIZONS

December 14, 1959

What Is An Engineer?

"The best engineers go into design, the poor ones into production, management or even sales." This is a common opinion, but one unsupported by fact. However, it is true that technicians and shop-trained men are taking over many production and operating functions once handled by engineers; and physicists, chemists and mathematicians are joining with engineers in R & D. This has suggested to some educators that the unique function of the engineer is design, that curricula should stress design courses, that it is the design function that will survive as the core of engineering.

What is an engineer? The licensing laws seem to show him as someone with a recognized degree, a knowledge of analytical and design procedures in his particular field, plus some specialized background in such civil-engineering areas as structures, and experience in engineering. College curricula are much less specific, industrial classifications less specific still—the latter ranging from an engine operator or maintenance specialist to anyone in production or design who utilizes empirical or analytical methods to improve product or process. And society in general currently considers anybody of responsibility in industry as an engineer, and any engineer with creative ability as a scientist, particularly if he has to do with aircraft, missiles or space.

The facts are that none of these concepts are accurate on a long-term basis. The licensee may end up in sales or management as frequently as the non-licensee, the engineering graduate may drift, initially or eventually, into merchandising, science, invention, law, or anything else. Likewise, the other concepts of engineering can be challenged and defeated.

What, then, is an engineer? You probably have read of the formal efforts at definition or have been involved in informal ones. Let's set the stage with Thomas Tredgold's 136-year-old definition: "Engineering is the art of directing the great sources of power in nature for the use and convenience of man." Then the engineer can very easily be defined as "One who directs . . ."—or be modified to "One who prepares the necessary technical instructions for directing. . ."

These are nice, loose—and very vague—definitions that include almost everybody who can spell. We still like better this simple series (PE—July 28 '58—p 17):

Science uncovers the secrets of nature. Engineering applies those secrets to the needs of man. The scientist is a trained mind that finds out *why*, the engineer a trained mind that finds out *how*.

This is, of course, too simple. One must define "secrets" and "trained mind." But any group desirous of such definitions will prepare, and insist upon, its own anyhow. We'll simply say that to us the "trained mind" is that one with an analytical approach, a probing attitude, a willingness to cut through sentiment and hokum, a desire for the truth. Thus the scientist and engineer can work in either order and rank equally; the scientist finding the reasons why what the engineer designs will work.

NO. 2 OF A SERIES
"How to Design Welded Aluminum Structures"

New Alcoa Yield Strength Concept Reveals Latent Strength of Welded Aluminum

Mr. Harry N. Hill, *Engineering Design Division Chief, Alcoa Research Laboratories, Aluminum Company of America reports research findings presented at the 1959 annual meeting of the American Society of Civil Engineers.*

This is the second in a series of informational articles describing new concepts in the strength and characteristics of welded aluminum. Reports in this series are based on extensive, continuing investigation at Alcoa Research Laboratories, where advanced methods for the use of aluminum structures are being explored.

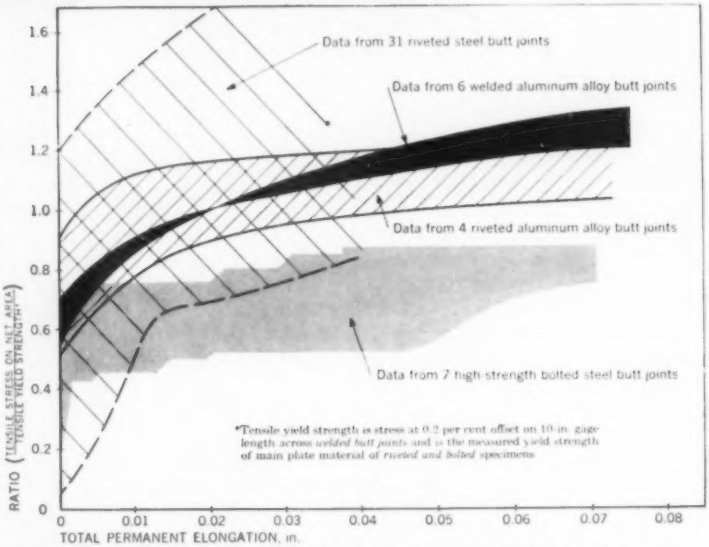
Use of the 10-in. gage length concept recommended here generally produces yield strength values from *30 to 40* per cent *higher* than minimum yield strengths found in and adjacent to welded areas! Adoption of this new design rule will enable designers to take full advantage of the strength of aluminum in welded structures.

In actual practice, it has often been found that the suitability of a structure is not determined by its ultimate strength but by its ability to carry load without significant yielding or permanent deformation. Design of these structures is based on yield strength of the material, modified by an appropriate factor of safety.

Yield strength of aluminum alloys is the axial stress that will produce a permanent change in length of 0.2 per cent in the portion of a standard test specimen having a uniform cross section. In this test, the length for measurement is unimportant, although a 2-in. gage length is commonly used.

If the test specimen contains a butt-welded joint at the middle of the length of uniform cross section, yielding will occur first in the immediate vicinity of the weld, because the heat of welding has softened the metal in this region. The yield strength value of such a piece will, therefore, depend upon the gage length tested.

Experience tells us that it is not reasonable to base a design on the yield strength of the material in and adjacent to the weld since yielding confined to these regions is so localized that the total effect on a welded structure is insignificant. To provide more realistic yield strength values across a welded joint, *it is advocated that such values be determined as the stress corresponding to 0.2 per cent permanent set on a 10-in. gage length.* This permits inclusion of some high-strength material unaffected by the heat of welding. Verification of this technique has been achieved in extensive tests at the Alcoa Research Labs. A future article in this series will provide further supporting data.


Data from 31 riveted steel butt joints
Data from 6 welded aluminum alloy butt joints
Data from 4 riveted aluminum alloy butt joints
Data from 7 high-strength bolted steel butt joints
*Tensile yield strength is stress at 0.2 per cent offset on 10-in. gage length across *welded butt joints* and is the measured yield strength of main plate material of *riveted and bolted* specimens
RATIO (TENSILE STRESS ON NET AREA / TENSILE YIELD STRENGTH*)
TOTAL PERMANENT ELONGATION, in.
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08

Permanent Elongation of Welded, Riveted and Bolted Joints

A basic premise of this new concept was that a welded aluminum joint should function much as a riveted or bolted joint. The chart demonstrates that the nature of the yielding of *welded aluminum* alloy butt joints based on the 10-in. gage length yield strength is *about the same* as that in *riveted or bolted joints* of aluminum alloy or steel.

The first article in this series of new design concepts for welded aluminum structures dealt with the "reduced-strength zone." Subsequent subjects will feature strength of welded members in tension, strength of welded members in compression, strength of welded beams, fillet welds and design data.

For top quality aluminum welding products such as consumable electrodes, welding and brazing rods and fluxes; and solder and soldering fluxes; contact your nearest Alcoa sales office. For more complete information on "Designing Welded Aluminum Structures," write Aluminum Company of America, 1760-M Alcoa Building, Pittsburgh 19, Pa.

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Mechanisms Feature Latest in Packaging Machinery

- **Ingenious devices increase speed of machines shown at national exhibit**
- **Automatic and semiautomatic lines built around variable-speed drives**

NEW YORK—Mechanisms to warp, pack, stamp, label, fill, weigh, seal and cap were features of the automatic and semiautomatic machines shown at the Package Machinery Manufacturers Institute show. Though not aesthetic in appearance, they were beautiful in engineering and design. High rates of production, interchangeability and simplicity keynoted the engineering and design of these machines.

Higher speeds were reported for a large number of the machines. Pak-Rapid Inc, for instance, showed equipment that can package any product up to 1¼ in. thick at speeds in excess of 60/min. Higher speeds are achieved over earlier models by applying continuous-motion principles to feeding-in, sealing and cutting-off of the web packaging material, coupled with intermittent motion of the product-feeding attachment.

Packaging speeds of 200/min. were demonstrated on equipment made by the Simplex Plant of FMC Packaging Machinery Div. Side-weld bags of polyethylene from 2⅜-in. sq to 30 in. wide by 40 in. long are possible at this speed. Sealing knife is arm-mounted and supported by a heavy cast back-up bar with 10 adjusting screws to insure uniform contact with the sealing roller. Web path (below) is direct and easily accessible.

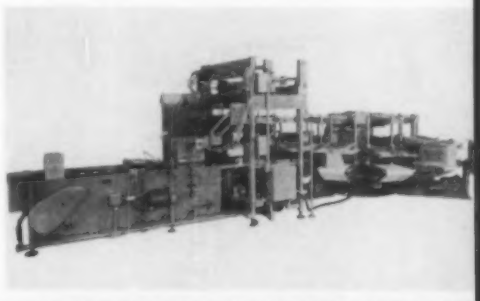
Dielectric units were also given credit for increasing machine speeds. Pennsylvania Frosted Food Co reported that incorporation of two such units increased normal production rates by 50%. High speed soared to 80% beyond the top rate allowed by previous methods. Dielectric sealing uses high-frequency radio waves to create a field into which the carton flaps and glue area are placed after the adhesive is applied. Adhesive becomes hot enough in the field to heat carton wax in area of glue pattern. Once the wax is melted, the adhesive reaches the board stock and forms a water-resistant bond. Compression time is a matter of seconds.

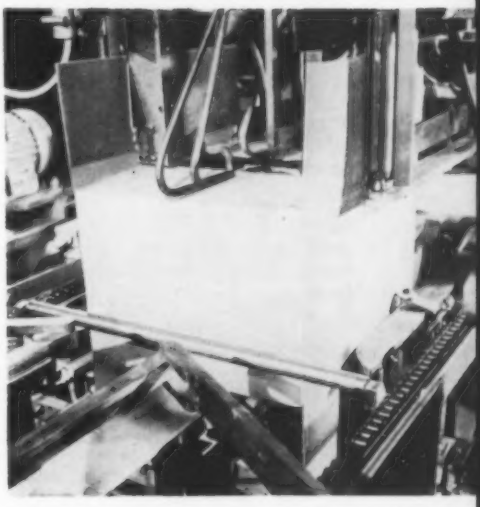
Automatic and semiautomatic machines were the rule rather than exception. One, a glue sealer manufactured by J L Ferguson Co for GE, adjusts itself automatically to a wide range of case dimensions fed in random order. This unit glues, seals and discharges in a single automatic operation. Cases are conveyed to the

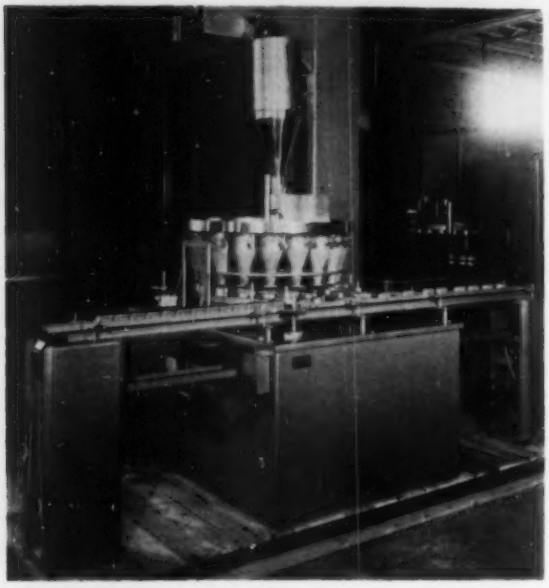
(CONTINUED ON PAGE 22)

Easy maintenance and high speed . . . are offered by this Simplex machine which turns out 200 bags/min. Side frames, gearing, bearings and drive are all large and sturdy. Controls and major moving parts are conveniently located for adjustment and inspection.

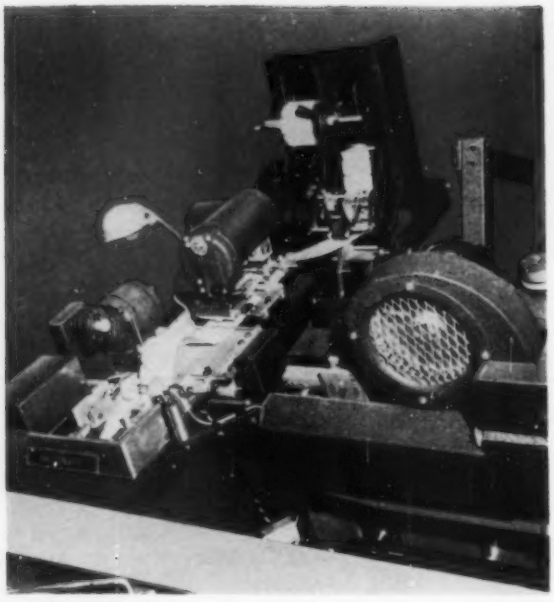
Automatic sealing . . . of random-size cases is a feature of the Ferguson sealer. Case width is measured by parallel arms, height by photocells. Case width automatically adjusts spacing of upper and lower glue rolls. Photoelectric cell sets upper glue-roll height. Rotary compression unit applies pressure while glue dries, automatically discharges sealed cases.







Combination of components . . .
lifter, packer, carrier by Frazier & Sons, forms basis for automatic line. Elevator feeder carries free-flow, nonliquid product to volumetric filler, which is synchronized with container line traveling by on conveyor. Variable-speed drive permits combining with other units to cap, label or seal filled containers.



Label applicator . . .
places pressure-sensitized labels on sealed polyethylene packages. Machine, designed by Amsco, is equipped with a power unwind (top) and can be operated, as here, with a printing unit. Label attachment is adaptable to any conveyorized automatic or semi-automatic line.

machine and centered. Tapered rollers allow the outer lower flaps to open partially as the case travels, onto a package plate. This supports case and contents as lower flaps are fully opened. Width and height adjustment set timing for gluing sequence through a cam and mechanical arm that regulate a hydraulic valve on the glue tank.

Once through the gluer, a "plow share" folder closes the flaps. Case is transported to a rotary compression unit that applies pressure until glue sets. Lower platen of compression unit is a conveyor; upper platen is a pressure plate. A hydraulic piston lowers the upper platen and maintains desired pressure for sealing. At end of sequence, platen rises and a continuously driven set of friction wheels is forced against the lower platen by the hydraulic piston; the sealed case is then discharged to the take-away conveyor.

Three components, a lifter, packer and carrier, are combined to form a packaging unit as designed by Frazier & Sons. Buckets of the elevator-feed conveyor are of nylon for easy removal and replacement. Nylon guides track the buckets and eliminate lubrication. Electronic controls keep the receiving hoppers at a controlled level, and a variable-speed drive permits integration of the unit with other pieces of machinery.

The label applicator, by Amsco Packaging Machinery Inc, is conveyor-fed. It accepts packages and automatically affixes a perforated-edge, pressure-sensitized label. Activated by an electric eye, the attachment affixes one label to a package and can handle 144 packages/min. Variable-speed drive allows integration with a printer and other equipment. ■

Glass Wrap for Rocket Engines Reduces Weight, Cuts Cost

CANOGA PARK, CALIF—Plastic-reinforced glass roving in place of welded steel bands has reduced weight of the Atlas booster engine's combustion chamber by 25%, Rocketdyne engineers report. The new method cuts the cost of this engine section by an estimated 20 to 25%, and saves appreciable time by eliminating intricate welding and difficult inspection. Rocketdyne foresees application of this idea to the fabrication of many other cylindrical and tubular structures which have high internal pressures.

The method consists of wrapping the chamber with epoxy-impregnated 20-end glass roving—an end contains 200 filaments, each 0.0004 in. dia. Winding is under moderate tension not high enough to be considered prestressing but sufficient to give close packing of fibers. (*PE*—July 20, p 46).

In the original Atlas booster, the combustion chamber was reinforced by a series of steel hoops welded to the tubes that make up the chamber wall. A second set of hoops was then welded over the first to withstand the high chamber pressure. The entire assembly required painstaking inspection to ensure integrity of the welds.

With wrap-reinforcing, Rocketdyne engineers avoid drilling, finishing or any subsequent operations that might weaken the completed structure. Wrapping is a final operation and any attempts to "clean up" the final finish are avoided. The completed part is oven-cured. During this step

(CONTINUED ON PAGE 24)

Some Ideas

for your file of practical information on drafting and reproduction from

KEUFFEL & ESSER CO.

Frankly, we hope you're a fusspot. If you are fussy about the way you work, and proud of it, we think you'll enjoy knowing about three K&E items which reduce the effort required to get pin-neat results. Our first suggestion is . . .

A Better "Mattress" for Your Drawing Board

For effortless drafting, a good board cover is about as important as a good mattress is for sound sleep. Which is why so many draftsmen swear by LAMINENE® (N 70), the only *laminated* board cover material made. An exclusive, patented K&E process gives LAMINENE several very practical advantages over plastic coated papers. You can stretch it, drumhead-tight, over your board. All you do is wet the back, then secure the ends by taping or stapling to the underside of the board. After drying, LAMINENE grips the board as if cemented – there's no rippling, no stretching with the weather, no slack to take up. Its "drafting feel" is perfect: just the right balance of firmness and resiliency. LAMINENE'S non-glare surface makes it easier on the eyes, too, even under fluorescent lighting. You can expect to leave the board feeling fresher, even after a long day.

What's more, LAMINENE won't crack or scar like a plastic coating. Its laminated film surface is flexible, and stays that way – no crevices form to pick up workaday grime. It's easier to clean, too. A little soap and water is all it takes to keep LAMINENE looking like new.

LAMINENE is available in White or Eye-Ease Green; plain or with 4 x 4, 8 x 8 and 10 x 10 grids to the inch, which act as permanent two-way tracing guides. A free sample can be yours in a few days if you write us today. If you've never tried a laminated board cover, we promise you a new experience!

Stickers With Delayed Action

Want to eliminate a time-consuming chore? You can cut down on tedious repetitive lettering by having title blocks, specifications, and other symbols or legends printed

– clearly and sharply – on DULSEAL™ (74). This tissue-thin film has a delayed-action adhesive on the back, and a dull-finish face for easy writing or printing. Stickers made of Dulseal can be firmly positioned—and re-positioned hours later, just as firmly. The adhesive takes 24 hours to set. Once it does set, a permanent bond is formed with the paper or cloth beneath. Dulseal is chemically stable, and the adhesive will not bleed, even in hot copying machines.

Repeated erasures on Dulseal will not affect its "take." Produced by an exclusive process, the "tooth" is *built into* the surface. Transparent and low in reflectivity, Dulseal stickers will not affect the transparency or printing speed of your drafting medium. K&E supplies Dulseal in sheets, rolls (printed to your specifications if you wish), and as a mending tape in a handy dispenser. Try a sample, on us!

3 To Keep Clean

Best way to keep your tracings clean: don't let them get dirty. A mighty easy way to achieve this is to sprinkle the tracing lightly with gum eraser particles, while working. Then, triangles, T-squares, and scales stay clean, and clean the surface *automatically*, as they are moved back and forth. The particles will not dry out or harden – they contain no grit or abrasives. They'll actually improve the ink taking qualities of your drafting surface.

For this purpose, K&E supplies cleaning particles put up in three different ways. We think the new plastic squeeze-bottle (3036C) is the handiest of all. The shaker-top can (3036) has also been a drafting-room favorite for some time. And, for double-duty cleaning, we suggest the ABC Dry-Clean Pad™ (3037), which holds slightly coarser granules that sift through soft mesh. The ABC Pad also comes in handy for wiping a complete tracing after it is finished, or for preparing certain surfaces for ink work. Or for an overall pre-cleaning, since the best way to insure clean tracings is never to let soil build up.

The proverbial ounce of prevention is worth the traditional pound of cure!

These K&E products, and others that can make life easier for you, are available from your nearby K&E dealer. See him soon . . . or send us the coupon below for further information and samples.

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Please send me samples of LAMINENE® Drawing Board Surface Material, and DULSEAL™ Tape . . . plus information on K&E cleaning powders.

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_____

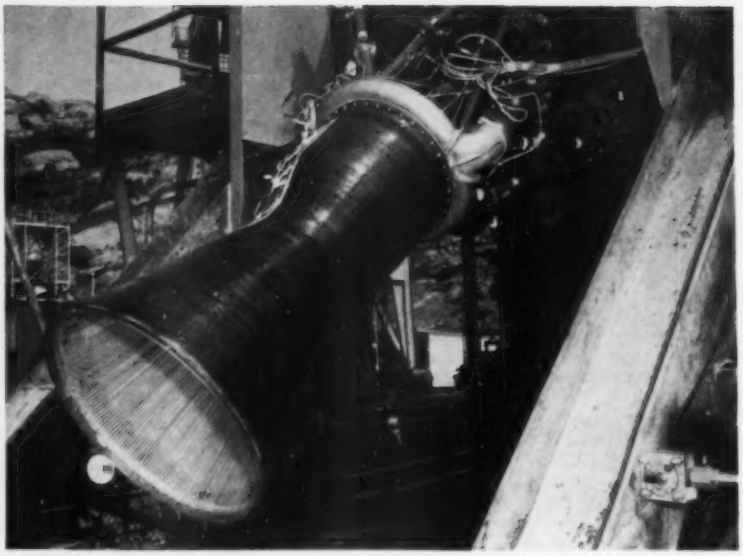
2002

(CONTINUED FROM PAGE 22)

it is rotated to prevent resin from migrating and producing variations in strength and balance.

Experiments conducted the past four years prove that the roving must be of extra quality with uniform filament thickness and have a moisture-resistant finish. Test parts exposed to the standard military humidity cycle show a permanent loss of as much as 70% of their total strength when conventional fibers are used; moisture-resistant fibers keep this loss to less than 10%.

Rocketdyne engineers point out that this test far exceeds anything the parts might encounter under operations. Design safety factors have been stretched to allow reduction if experience dictates. ■



Glass wrap for Atlas engine . . .
To achieve this final wrap form on test stand, engine is mounted on a winding machine supported by a mandrel that fits inside the area to be wound. The mandrel gives extra support in this area as does an additional retaining ring in the nozzle section. Six 4-in. longitudinal strands epoxy-dipped and woven from 20-end glass are clamped in place and the winding is applied. Tension arm and winding speed are cam-controlled so that roving is applied uniformly over the varying diameter of the chamber.

Student Draftsmen Pay Off for Aircraft Firm

SEATTLE — Branch drafting offices manned by engineering students from two local universities are paying off for Boeing Aircraft Co—not only in services rendered but also as a source of engineer employes.

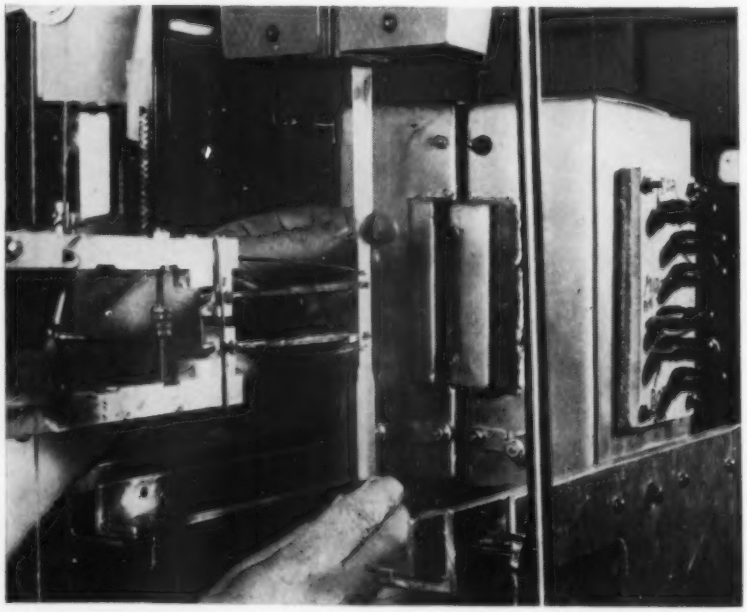
At outset of the 3-year-old program, Boeing hoped for an average of 2 hr for each Advanced Design Change Notice incorporated by the undergraduates. The average is now 1.575 hr. The program, coordinated with the Univ of Seattle and the Univ of Washington, has been on a paying basis from the start, costs from the first quarter having been reduced by 54% during ensuing semesters.

Of 23 Seattle Univ engineering students graduating last year, 17 accepted positions with Boeing Technical staff. The remaining 6 were chemical engineers. The Univ of Washington "Design Support Group," twice the size of Seattle's, is expected to reach 100 student-draftsmen next semester.

Student engineers in both universities may apply for acceptance by Boeing during their sophomore year and can work a 12- to 20-hr week provided they are carrying a full course load and have good marks.

The program is important to Boeing in that it helps level off drawing-maintenance work peaks prior to contract closing times. ■

Load-strain Factors on Alloys Now Recorded



SEATTLE—Boeing engineers have developed a way to effectively record load-strain factors on new alloys and test them in protracted heat.

The method calls for fitting sockets at the ends of extensometer arms over steel balls spotwelded to the specimen. Until now, the spring-loaded, knife-edge grip furnished on standard extensometers failed to indent and hold on titanium alloys and stainless steels at elevated-temperature tests.

Now, sockets lock onto the ⅜-in.-

(CONTINUED ON PAGE 26)

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P-K SEMS reach your assembly line pre-assembled, ready for instant use. Washers cannot come off—can never be mislaid or misplaced—insures washers on screws...not on the floor! Double inventory and double parts handling is completely eliminated.

P-K SEMS can be hopper fed for automatic driving. Inspection rejects due to omitted lock washers are impossible—fastenings stay tight and firm. P-K Sems assure concentric washer seating.

STAPS® are standard P-K fasteners, pre-assembled with nylon or neoprene washers for effective control of leaks, squeaks, crazing and electrolysis, in all types of metal structures and assemblies.

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No. 8 of a series

Eastman 910 Adhesive solves another design bottleneck

Directly measuring dimensional changes in structural members under stress, strain gages provide aircraft designers with performance data at almost any point in the airframe during flight testing. As many as 8,000 gages have been used during the flight testing program of a single aircraft.

Because of its rapid setting characteristics and its ability to adhere to virtually any material, Eastman 910 Adhesive has become the preferred adhesive for attaching strain gages.

Conventional adhesives require up to 24 hours curing time before reliable readings can be taken. *Use of Eastman 910 Adhesive can reduce this waiting period to less than 5 minutes.*

Eastman 910 Adhesive is making possible faster, more economical assembly-line operations and new design approaches for many products. It is ideal where extreme speed of setting is important, or where design requirements involve joining small surfaces, complex mechanical fasteners or heat-sensitive elements.

Eastman 910 Adhesive is simple to use. No mixing, heat or pressure is required. Upon spreading into a thin film between two surfaces, setting begins immediately. With most materials, strong bonds are made in minutes.

What production or design problem can this unique adhesive solve for you?

Bonds Almost Instantly ...Without Heat, Pressure or Catalyst

For a trial quantity (⅓-oz.) send five dollars to Armstrong Cork Co., Industrial Adhesives Div., 9112 Irvin Street, Lancaster, Pa., or to Eastman Chemical Products, Inc., Chemicals Div., Dept. P-12, Kingsport, Tenn. (Not for drug use)

(CONTINUED FROM PAGE 24)

dia ball (photo p 24) and permit any variety of specimen motion, at the same time eliminating slippage of extensometer arms. It registers accurately every iota of strain as tension in the specimen increases.

Constant bearing pressure is maintained against the balls by spring-loading the arms whose tips are drilled to accommodate the balls. A templet serves to space the balls 1 in. apart on the specimen's centerline. Attachment of steel balls to a specimen does not distort a reading of its true properties under stress, according to Jack D. Wilson, Boeing engineer who developed the method.

With the new method, Boeing welds a beaded thermocouple to the specimen, for heat sensing, rather than wiring it. The fused metal-to-metal contact permits positive control of the specimen and is more reliable than wire, which Wilson says slackens during heating and allows the bead to come loose during testing.

In 391 tests at room temperature, only twice did the ball or the thermocouple welds suffer fractures before the speciment did. In 431 tests at a elevated temperature, the ball or the thermocouple welds failed before the specimen in only 30 cases.

Boeing prefers spotwelding to brazing and soldering because it does not involve heating the tensile specimen, risking a change in mechanical properties of the material. Depth of penetration was obtained by again using the templet. ■

Industry Seeks Fluids, Pumps for Mach-3

DETROIT—Mach-3 speeds for commercial transports and hydraulic systems in the 4000-psi range are immediate goals of US industry and government, now bending all efforts to develop hardware and fluids that will function efficiently under these conditions. This was revealed at the recent Vickers 1959 Aircraft Hydraulic Conference.

Silicones, silanes, superrefined mineral oils, polyphenyl ethers, trymethylpropanol esters, and silicone-ester blends are among the fluids under most active investigation, according to Air Force's Wright Air Development Command. Purpose is to find a fluid

(CONTINUED ON PAGE 29)

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Kodak reports on:

a little something for the taxpayers . . . special lubricants without diplomatic maneuvering . . . the restraining effect of our inhibitions

Microelectronics

Ever hear of the Diamond Ordnance Fuze Laboratories? It's a Department of the Army agency in Washington. To support DOFL, the average citizen shells out the federal tax on, let us say, several gallons of gasoline a year or a little tobacco. Since a fuze is a device which times an explosion to blow up his enemy, he probably wouldn't mind the expense if it were explained to him. But, *mirabile dictu* and happy day, prospects brighten that the piddling investment will pay off beyond the dreams of avarice!

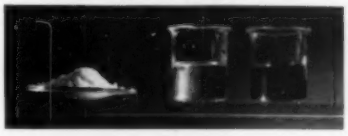
DOFL has spawned "microelectronics," the shrinking of electronic assemblies to 1/100 normal size. DOFL became involved through the proximity fuze program, which requires very small and exceedingly rugged components. We are involved through *Kodak Photo Resist*, *Kodak High Resolution Plates*, and *Kodak Ektagraph Film*. Microelectronics may be bigger than both of us. It may make possible the placement of electronic devices inside the body, for diagnosis or for replacement or repair of human organs with electronic equivalents. It may permit a new directness in the study of the central nervous system.

The theme of microelectronics is that if you want environment-immune, highly "intelligent" circuitry that can handle problems of logic and fit into a tenth of a cubic inch of space or so, you quit at an early stage of the design thinking of transistors, diodes, capacitors, resistors, and such. Instead you think of the circuit as one or more plates half a millimeter thick and fabricated as intricately as necessary out of various conductive, semi-conductive, and dielectric materials disposed among the three dimensions of each plate.

The technique (at least prior to mass-scale production) uses *Kodak High Resolution Plates* on which the geometry of the various sub-circuits is photographed from drawings at great reduction. These then become the masks under which are exposed to ultraviolet light the circuit substrate plates that have been coated with *Kodak Photo Resist*. Where the mask passes u-v, subsequent processing removes the resist and lays open the substrate for either removal of material or insertion of other materials by evaporation, printing, electro-deposition, or chemical deposition. In some operations, deposition is done by squeezing material through openings left in a fine screen in accordance with an applied pattern of blocking, photographically reduced to *Kodak Ektagraph Film*.

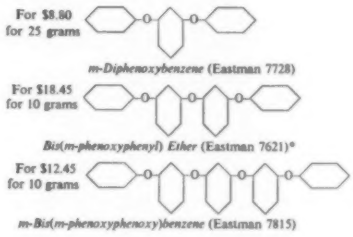
The next thing to do is to send to Eastman Kodak Company, Special Sensitized Products Division, Rochester 4, N. Y., for a reprint of "The DOFL Microelectronics Program." Literature on the three Kodak products mentioned here will be thrown in. Thus we nudge you toward great undertakings.

600°F is tougher than 350°F



To demonstrate how passably these two liquids and this solid perform as oxidation-, corrosion-, and radiation-resistant lubricants for gears and bearings operating up to 600°F in up-to-date kinds of machinery must have taken another little chunk of government money, of which only a pittance found its way into our pockets.

Now that the pure, undoctored, unsubstituted meta-linked polyphenyl ethers are revealed to rate high for chemical sturdiness, lubricity, and retention of the liquid state over a broad temperature range, we find it in our hearts to enable the experimenter to acquire them in a small, quiet commercial transaction without diplomatic maneuvering.



Perhaps one of our markets for these polyphenyl ethers will be for use as foils against which to demonstrate the superiority of new classes of lubricants as yet unrevealed, just as the polyphenyl ethers stand up for many hours to conditions that devastate 350°F lubricants to stiff sludges or vapors in minutes. Two decades ago, when we were in the high-vacuum business and considered ourselves pretty smart in diffusion pump liquids, we developed some phlegmatic esters that now serve as the goats for the polyphenyl ethers to beat.

Small, quiet transactions are the mainstay of the Eastman Organic Chemicals Department of Distillation Products Industries, Rochester 3, N. Y. (Division of Eastman Kodak Company). Our current "List No. 41" will tell you of our organic chemical wares, some 3700 of them.

*There has been some 40° to 800°F talk about this one.

Color for facts, not kicks

If we wanted to, we could in good conscience call "S.O. 260" the fastest color film ever made. We don't want to.

There are other reversal color films you can expose on the assumption of an outrageously high index, force-develop, and obtain an image out of. All we're saying is that outrage for outrage, "S.O. 260" loses less in color saturation, maximum density, and fineness of grain than others. This advantage can be so important in data acquisition—flame studies, aerodynamic studies, attitudes of informatively painted flying objects, for example—that we had better not rely on rumor and word of mouth to spread the news of its existence.

This is not intended for the photo-hobbyist who gets his thrills by bragging to his buddies, "I shot this at an Exposure Index of 600." Wise or foolish, we dislike to see him sacrifice the potentiality of pictorial excellence instead of contriving to put a little more light through his lens. Maybe it's none of our business, but such are our inhibitions. We draw to his attention *Kodak High Speed Ektachrome Film*, *Kodak Ektachrome Film* (*Process E-3*), *Kodak Ektachrome Film* (*Process E-2*), and *Kodachrome Film*, any of which can yield him beautiful and impressive transparencies.

"S.O. 260" currently takes the form of 16mm film with a perforation pitch of .3000" in 100', 200', and 400' lengths and 35mm film of .1870" perforation pitch in 100' and 400' lengths. These are pitches for high speed motion picture cameras. If you recognize that and have a need for data from color changes (changes, *not so much the colors themselves*) *photographed under very unfavorable conditions, initiate an inquiry about "S.O. 260" Film with Eastman Kodak Company, Photorecording Methods Sales Division, Rochester 4, N. Y. You will be put in touch with the proper parties.*

Prices quoted are subject to change without notice.

Kodak
TRADE MARK

This is another advertisement where Eastman Kodak Company probes at random for mutual interests and occasionally a little revenue from those whose work has something to do with science

"Here's a boxful of cost-cutting, product-improving ideas for you"

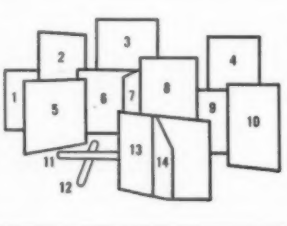
In versatility, performance and cost, Vulcanized Fibre may help crack your next design problem

For proof, look at this National product and its almost unbelievable range of uses. To name a few: delicate surgical instruments; rail joint insulation for railroads; clothes hampers for the home; dense, durable gears and cams; flexible backings for abrasive disks; arc chutes for lightning arrestors; motor insulation; punched tape for data processing machines; formed athletic guard equipment.

Among engineering materials you'll find National Vulcanized Fibre unique and surprisingly economical. It weighs only half as much as aluminum. It has unsurpassed arc resistance, low thermal conductivity, excellent resilience and high abrasion resistance. It absorbs sudden and repeated shock and impact without failure. And it is available in a fire resistant grade.

After 100 years, users are still finding new things they can do *to* Vulcanized Fibre. It can be machined, polished, painted, embossed, lacquered and combined with other materials, such as laminated plastic, aluminum, wood, rubber, asbestos or copper. It can even be formed or deep drawn into intricate shapes. Available in both standard and special forms and sizes.

Send for our special kit of samples (shown above)—write on your letterhead please—and evaluate the design possibilities personally. Let us know what use you have in mind. We'd like to help. National Vulcanized Fibre Co., Dept.H-12,Wilmington 99, Delaware.



1. "Peerless" Electrical Insulation. **2.** Embossed, vinyl finish. **3.** Corrugated "Peerless" .010. **4.** Fibre and "Mylar." **5.** Cold embossed. **6.** Fibre-Copper, two-sides copper. **7.** Black Commercial. **8.** Fibre-Laminated Plastic, two-sides fibre. **9.** Red Commercial. **10.** Corrugated. **11.** Rod. **12.** Tube. **13.** White. **14.** Fibre Armored Plywood.

CHOOSE FROM THESE MATERIALS...

Vulcanized Fibre: 10 standard grades; many special grades.

PHENOLITE® Laminated Plastic: over 80 standard and modified grades; paper, cotton fabric, nylon, asbestos, glass fabric, cotton and glass mat bases; phenolic, melamine, polyester, epoxy, "TEFLON" or silicone resins.

PEERLESS Electrical Insulation: coil, strip, corrugated.

Extruded Nylon: 2 grades; rod, strip, pressure tubing, special shapes.

Polyester Glass Mat: 4 standard sheet grades; custom molded shapes.

PHENOLITE Copper-Clad Laminates: 10 standard grades.

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CIRCLE 80 ON READER SERVICE CARD

(CONTINUED FROM PAGE 26)

that will operate efficiently at temperatures as low as −65 F and high as 750 or 1000 F.

While none of these fluids yet meet the exacting requirements of the next family of air and space vehicles—including resistance to radiation in nuclear-powered vehicles, Republic Aviation reports "a great deal of information has been accumulated, though much more work must be done before an operational hydraulic system can be supplied."

Data gathered to date has stimulated R & D work by Republic on the components for such a system. Contracts have been let for a pump, servovalve, relief valve and checkvalve. The pump is to operate at 700-F fluid inlet temperature, in a 600-F ambient, at 4000-psi operating pressure and at speeds of 8000 rpm. The electrohydraulic servovalve must handle fluids at 1000-F and operate in a 1200-F ambient.

Development of a contaminant-tolerant pump was reported by Vickers. Originally developed for the military for hydraulic systems that share a common reservoir with the engine lube system, the pump can be made tolerant of contamination as high as 0.15 gm/gal. of fluid. Pumps so reworked can operate for 200 hr; previously, pumps reached an intolerable level of internal leakage in only a few hours of operation.

Fixed variable pumps, first introduced by Vickers 18 months ago, now include 9 models with displacements between 0.048 cu in./rev and 5.873 cu in./rev. Lighter and more compact than earlier pumps of yoke design, these pumps are expected to reach the 4000-psi, high-temperature range. ■

More Millions Awarded for Nuclear Subs

SUNNYDALE, CALIF—A US Navy contract for work on launching systems equipping four nuclear-powered submarines to fire the ballistic missile Polaris has been awarded the Westinghouse Electric Co. The $5,250,000 order is in addition to about $40 million that Navy has already awarded Westinghouse for development and production of Polaris launchers.

The four submarines are specially designed to launch the solid-fueled,

(CONTINUED ON PAGE 30)

Saint Nick enjoys the longest list of satisfied customers in history. The dependable old gent, always in step with progress, returns year after year to the same eager clientele.

Technic, too, enjoys the confidence of its customers. Our list of new friends grows annually, and happily we have retained all of our old ones, because they know they can rely on Technic quality and service.

And so, we, the producers of the world's best soluble precious metals for electroplating, take this opportunity to thank our friends, new and old, for your continuing faith in us, and to wish you a most prosperous New Year

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Vulcan Electric Tubular Immersion Heaters offer a choice of flange or threaded bushings; bayonet type, side or bottom outlet; copper, steel, stainless or alloy sheath; single or three phase; 500 to 10,000 watts (or higher); 120, 240, 480 volts (or higher); pressures up to 3500 psi.

Vulcan Immersion Heaters are ideal for heat transfer to all types of liquids — water, oil, wax, paraffin, asphalt, tars, etc.; in tanks, boilers, urns, kettles and other containers.

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Company.....

Street & No.....

City & State.....

(CONTINUED FROM PAGE 29)

intermediate-range missile from either surfaced or submerged positions. When submerged these mobile missile sites escape detection by enemy radar. At present, nine Polaris submarines are being readied by the Navy.

Test launchers are built at Westinghouse's division here for underwater, surface and land-based launchers. Using compressed gas, the underwater test launchers repeatedly have ejected dummy missiles successfully from beneath the waters off the southern California coast. ■

Defense Dept. OK's Standardizing Manuals

WASHINGTON — Standardization of manuals for the operation and maintenance of weapon systems is being pushed by the Dept of Defense following a plan outlined by the Aerospace Industries Association. The Service Publications Committee of AIA, composed of technical-manual specialists from 83 companies and divisions of the aerospace industry, devised the plan of establishing a Technical Manual Standardization Committee in the Defense Dept.

This group will work through task forces assigned to specific problem areas—cataloging, maintenance, operations, overhaul and repair. Military and industry specialists will serve on the task forces.

Noting that the Air Force alone spends $250 million annually for technical manuals, and that numerous commands within each service produce a myriad of such manuals. Defense Dept believes that much money will be saved once the manual standardization committee is in operation. ■

Industrial Designers Told 'Know Thyself'

NEW YORK—Industrial designers must have a clear idea of their function if the profession is to become universally recognized. This admonition was offered by Donald L. McFarland, chairman of the board of directors of the American Society of Industrial Designers, before their 15th annual meeting here.

While the industrial designer does not specialize in marketing or engi-

(CONTINUED ON PAGE 32)

MB

ISOMODE® PADS

shaped for vibration isolation at low cost

MB ISOMODE Pads cut vibration transmission, soften impact shock, sharply reduce maintenance due to vibration. Developed for a wide range of shock and vibration absorption assignments, they're being used instead of costlier, custom-designed rubber mounts or steel springs.

One designer, for example, was troubled with difficulties in matching stiffness, or K factor, of helical springs used to absorb pulsations of a long, vibrating conveyor. Replacing them with several plies of ISOMODE Pads gave excellent results. And adding or subtracting a ply permits full field control over resilience.

ISOMODE Pads can be supplied in specified shapes. They are 3/4" thick neoprene, ribbed on both sides, come in various durometers, have as much as 50#/ in² load capacity. Send for more data.

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A DIVISION OF TEXTRON ELECTRONICS, INC.
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Pioneer and leader in the field of vibration

This Complete RBM Control Family

is specially engineered for the air conditioning industry

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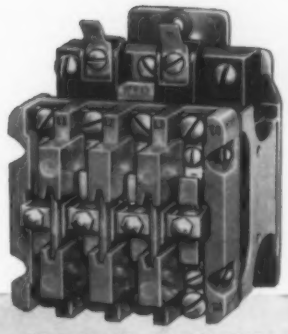
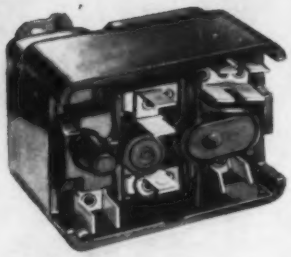
When RBM specially engineered its first air conditioning control, it quickly recognized the industry need for not just one . . . but for a *complete family*. So RBM has done the job. Now there is a single source for *all* magnetic air conditioning controls . . . each one meticulously engineered for its application. What's *your* requirement? See RBM.

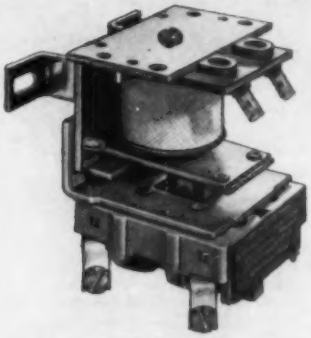


TYPE C—30, 40, 50 AMP. 2-3-4 pole 30 amp.—600 volts. 2-3-4 pole 40 amp.—230 volts. 2 pole 50 amp.—230 volts. Same mounting holes and coils for all ratings and pole forms.

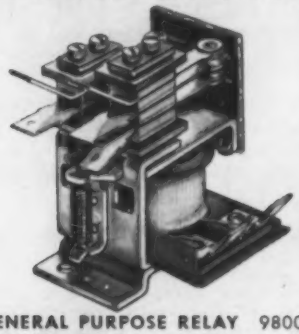
ALL PRICED TO MEET THE NEEDS OF VOLUME USERS



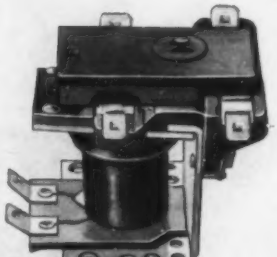
SERIES 128000 POTENTIAL STARTING RELAYS For starting single phase capacitor start compressors.



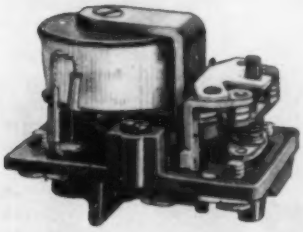
TYPE 80 CONTROLLER Specific design for nominal 3 HP or 3-ton single phase compressors.



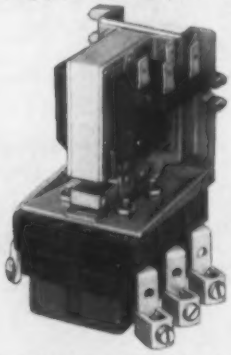
GENERAL PURPOSE RELAY 98000 Series AC or DC. Permits engineering short cuts lowering your "finished product" cost.



TYPE 75 Low cost power relay. Dependably handles up to 6000 W. at 240 V., resistive load per pole. Compressor rating 2 poles, 18 amp. running, 90 amp. locked rotor at 250 volts.



SERIES 129000 SHUNT TYPE RELAY—SPNO, SPNC or NO-NC For standard commercial voltages. Other coils available for special application. For heater, fan control, general circuit switching, etc.



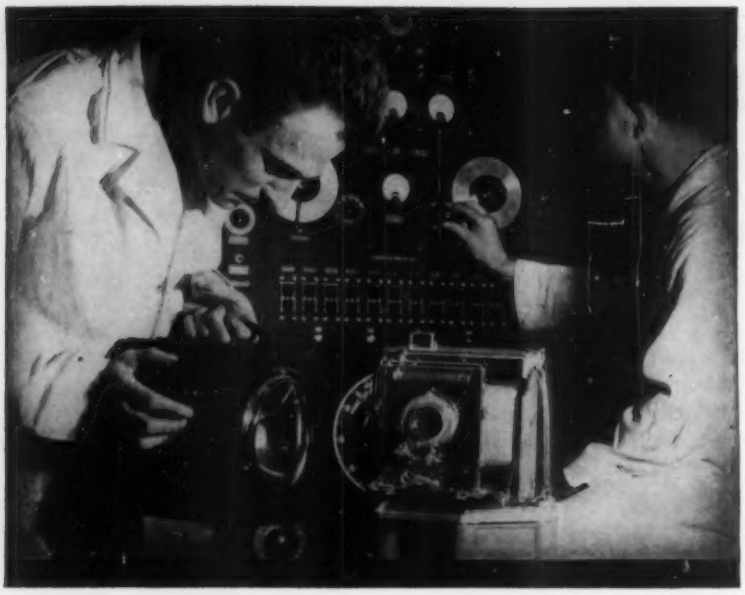
TYPE S—30—40 AMP. Low cost. Small size. Exceed rigid requirements of industry's largest users.

Consult your local RBM Product Application Engineer or Write for Bulletins 1030A, C-8, 1010A, 1060 and C-10.

RBM **RBM Controls Division**

ESSEX WIRE CORPORATION, LOGANSPORT, INDIANA

Factories Located at Peru, North Manchester and Logansport, Indiana



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(CONTINUED FROM PAGE 30)

neering, McFarland declared, he does combine elements of both to create a visual representation of a product for the customer.

INDUSTRIAL DESIGNERS FUNCTION

Decision-makers are often unable to visualize a product from a description or engineering prototype. The engineer, with little training in consumer psychology, does not always appreciate what makes a product sell. This is where industrial designers can be of greatest value, McFarland declares, and it is where they should concentrate.

The industrial designer is in the best position, McFarland said, to know what information is needed from consumer surveys before engineering design gets underway, and he should formulate the questions that need answers. He could make the survey as well, McFarland admitted, but it is better if that function is left to others. ■

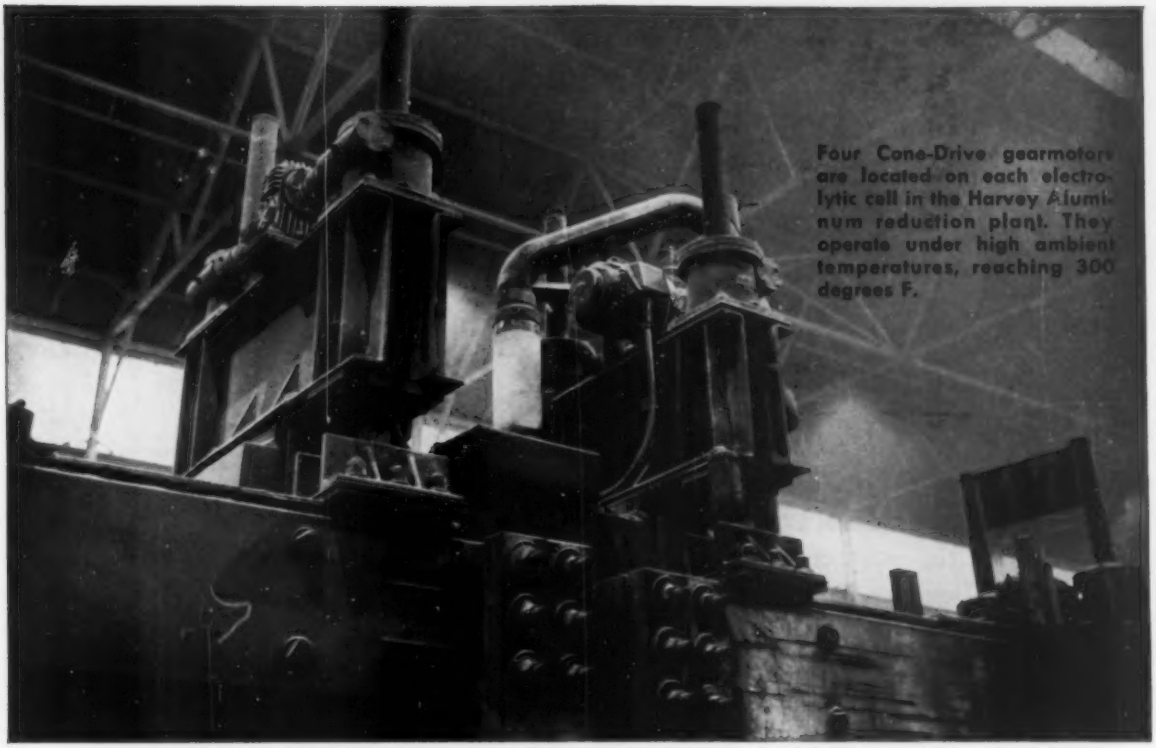
Torch Coats Tungsten Directly to Nozzle

NEW YORK—A rhenium undercoat to protect solid-propellent graphite nozzles is unnecessary when the tungsten finish is applied with a Linde Co plasma arc torch, according to reports by Linde engineers. Their studies conclude that torch-applied tungsten will withstand flame temperatures up to 5500 F and pressures of 500 to 1000 psi. Such nozzles will also hold throat erosion within engineering allowances.

When operating temperatures are higher, the report adds, a tantalum undercoat is suitable. The tantalum eutectic has a slightly higher melting point than the tungsten carbon eutetic.

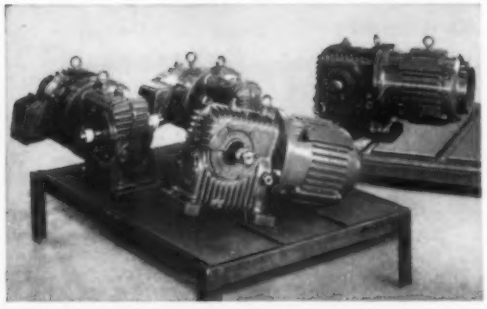
Elimination of rhenium undercoating points to substantial cost reductions. Rhenium costs 170 more than tungsten and its supply is limited. A tantalum undercoat for higher temperatures will cost about one-twelfth as much as rhenium.

The report says the torch method can eliminate rhenium undercoatings because it imparts higher velocities and temperatures to tungsten particles. This results in better density and bonding with the base material. ■



Four Cone-Drive gearmotors are located on each electrolytic cell in the Harvey Aluminum reduction plant. They operate under high ambient temperatures, reaching 300 degrees F.

1,000 CONE-DRIVE Gearmotors to produce 100,000,000 lbs per year at Harvey Aluminum



Four double-enveloping worm gearmotors used by Harvey Aluminum are shown here after test run in Cone-Drive plant. They were palletized in groups of four for shipment to Oregon smelter.

From its modern reduction plant at The Dalles, Oregon, Harvey ships primary aluminum in pig, ingot and billet forms all over America. The smelter includes the latest and most efficient equipment and operating techniques. Reflecting this modern equipment are 1,000 Cone-Drive double-enveloping worm gearmotors, used to control the height of anodes and casings in relation to the molten aluminum bath in each of the electric furnaces. Annual capacity is more than 100-million pounds.

The gearmotors are operated under high ambient temperatures that reach 300° F. This was an important consideration in Harvey's selection of Cone-Drive gearmotors. In addition, the ability to withstand the full force of stalled driving motors and constant reversing operations figured in Cone-Drive gearing's selection.

Cone-Drive double-enveloping worm gearmotors are available in a wide variety of styles and sizes. Models include standard shaft or hollow shaft with worm over or under or gearshaft vertical. Capacities range from ¼ to 40 HP and reductions from 3.3:1 to 240:1. Ask for Catalog No. 58 for complete specifications.

CONE-DRIVE GEARS DIVISION MICHIGAN TOOL COMPANY

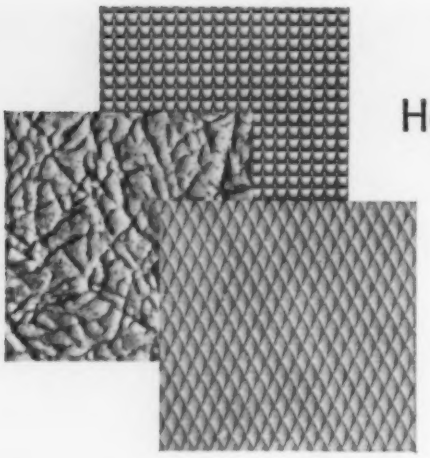
7171 E. McNichols Road • Detroit 12, Michigan • Telephone: TWinbrook 1-3111

DOUBLE-ENVELOPING WORM GEARSETS

DOUBLE-ENVELOPING WORM GEAR SPEED REDUCERS

DOUBLE REDUCTION WORM GEAR SPEED REDUCERS

DOUBLE-ENVELOPING RIGHT ANGLE GEARMOTORS



Here are

5 basic ways

...for product

Aluminum in its natural state never rusts, and resists the most common causes of corrosion. However, finishes can provide added corrosion protection, act as a barrier against abrasion and wear, and enhance the beauty of aluminum as well. Following are some of the most popular and effective methods of finishing aluminum surfaces.

Mechanical Finishes, used to add surface texture, include grinding, polishing, buffiing, blasting and scratch finishing. Buffing and polishing add reflectivity; blasting and scratch finishing provide a matte finish.

Chemical Finishes for visual effects and product protection are made with caustic and acid etches, chemical brighteners, phosphate conversion coatings and chromate conversion coatings. Chemical brightening creates specular finishes; caustic and acid etches form matte finishes; phosphate and chromate conversion coatings are used to provide a base for paint, and for added corrosion protection.

Electrochemical Finishes include electropolishing, electrobrightening, plating and anodizing. Electropolishing and electrobrightening levels the surface of metals and creates a more specular finish. Plating is used to create special metallic effects, and produces surfaces where good electric

And, to be sure you get the right aluminum—use Reynolds Aluminum

to finish aluminum

protection and appearance

contacts can be made. It has found wide use in the electrical industry. Anodized finishes are created by treating the metal anodically in electrolytes. This method creates a thin, hard and durable film of aluminum oxide on the surface. Clear or colored, anodized surfaces provide excellent abrasion and corrosion protection while enhancing the appearance of the metal surface.

Organic Coatings include the very economical alkyd-amines; the flexible vinyls; epoxy finishes for acid and/or alkali resistance; acrylic for general protection; low cost butrate for long coating life; air drying methacrylate; and silicone alkyds that withstand temperatures as high as 1000°F.

Porcelain Enamel Finishes are vitreous or glass compositions fused to the metal surface. Extremely useful as an attractive, low-maintenance and protective coating for architectural panels, building trim, store fronts, appliance parts and products subject to weathering and use. Luster and color can be easily controlled, and resistance to impact and shock is high. These finishes will actually add more rigidity to the metal base.

Write today for the Reynolds booklet offered below or contact Reynolds Engineering Service, for complete information and advice.

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Order your FREE copy of this informative booklet today!

Finishes for Aluminum

This new handbook describes the most popular surface finishes used on aluminum. Finish characteristics and processes employed are also explained in detail. Designed to provide information you need to select the best finish for a particular application, this booklet is offered free of charge, as a technical service from Reynolds Aluminum.

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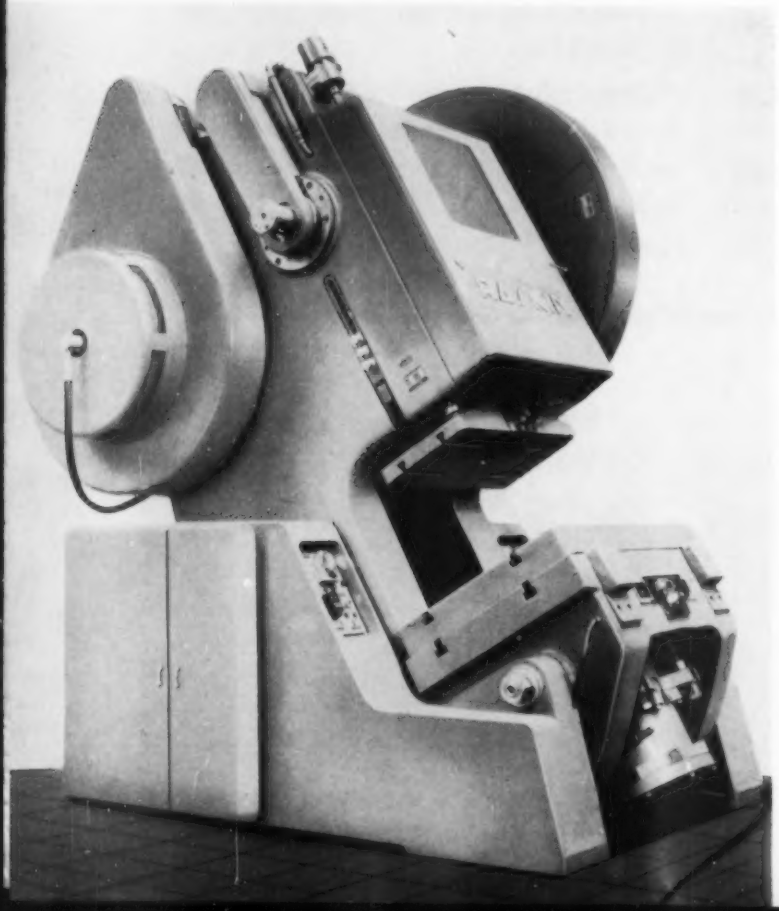
TRENDS
in appearance design

Some officers of the International Council of Societies of Industrial designers, from left: Misha Black (Great Britain), president; Pierre Vago (France), vice president; Sigvard Bernadotte (Sweden), vice president; the author, Peter Muller-Munk (US), chairman of executive board.

Inclinable press, Atelier Hubert Raskin, Belgium



Diesel locomotive Design Research Unit, Great Britain

HOW AMERICA

Peter Muller-Munk*

■ Contrary to popular opinion, both here and abroad, America's principal influence on European product design does not concern appearance or styling details. Rather, it is American industry's accomplishments in product planning and development that are opening the eyes of Europe's engineers and industrial designers.

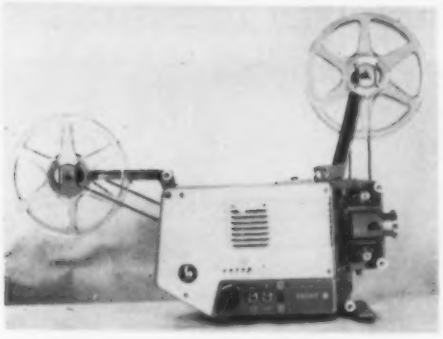
Not that management is entirely sold on the American approach. While the Europeans are beginning to realize the value of having trained specialists integrate engineering with appearance, they must still be shown that American manufacturers' methods can apply to anything smaller in scale than American markets, mass-production facilities and marketing techniques. One of the biggest obstacles to change may turn out to be the attitude of average European management toward its own sales staffs—that sales is a necessary but disagreeable evil.

However, European management is subject today to powerful new pressures—perhaps the greatest is the now-developing Common Market, which is opening the various countries to competition among themselves and creating a group of consumers that eventually will rival America's in size. The realization is growing that the product-development and planning techniques already developed in the US are an important guide in coping with these new ways of doing business.

Western European nations have for some time appreciated the importance of American experience and techniques. Virtually all of them, for example, have provided financial backing during the last eight to ten years for promoting industrial design in the industrial community and have encouraged practicing designers to form societies, institutes and other

* Managing partner, Peter Muller-Munk Associates, Pittsburgh; chairman of the executive board, International Council of Societies of Industrial Designers; Fellow, American Society of Industrial Designers

Room-divider refrigerator, Peter Muller-Monk Assoc, US



Motion-picture projector, Atelier Technes, France

INFLUENCES EUROPEAN PRODUCT DEVELOPMENT

such cooperative efforts. This backing has been so necessary that the average European industrial designer finds it hard to believe that Americans pioneered in this field without such support.

European industrial design schools also rely heavily on American experience; with the exception of Great Britain, where things are a little further along, Europe's first graduates are only now beginning to take jobs in the offices of European consultant designers and manufacturers' staffs. Almost none of the industrial designers to whom they will report have ever had such formal training. These men and women come from backgrounds reminiscent of the early American industrial designers: architecture, engineering, fine arts, crafts and the graphics industry. Only the outstanding industrial designers of Europe can be said to equal their American colleagues in appreciation of engineering considerations or their knowledge of production techniques. The top graduates of the best US industrial design schools can almost be considered the equivalent of most of the younger European designers now practicing.

Industrial design in Western Europe is still plagued with a few prima donnas, yet the use of an industrial designer's name as an aid to merchandising—common enough in this country—would be unthinkable in Europe. I believe even the consumers would resist.

At least one reason why such practice could not be followed abroad is the fact that often a given designer will have more than one account in the same field—a practice almost unheard of in this country. The relatively small number of potential accounts makes it almost impossible for a European designer to put together enough one-of-a-kind clients to provide an adequate income. Fees are proportionately much lower than in this country.

The European manufacturers do not object to this practice—in fact, sometimes they almost seem to encourage it, possibly in the mistaken notion that in this way they can learn what their competition is up to!

On the other hand, the European designer often faces secrecy often from the manufacturers that would seem unbelievable to his American counterpart. In the US the designer is allowed almost any information he needs on costs, processes, materials and other such essential factors. The European has trouble getting his client to give even the most rudimentary data—and when he does get it, he may find his client has only limited knowledge of his own manufacturing costs.

This designer may also meet with more resistance to his suggestions from his client's engineering staff than the typical American appearance specialist. But once he wins his engineering colleague's acceptance, he is likely to find a more highly developed level of aesthetic understanding and knowledge than in the US.

What's more, chances are that the European designer will continue working with the same engineers for as long as he has the account. This is because the typical engineer in Western Europe, upon graduating from engineering school, goes to work for the same company from which he later retires.

At least one significant indication of American influence on European product design is the proposal by a number of leading designers at last September's meeting in Stockholm of the International Council of Societies of Industrial Designers. They suggested that the term "industrial design" be adopted universally. Although we in the US often think the name we use for this profession has serious limitations, it seems much more successful than that used in Germany ("industrieller formgeber"), in France (esthetique industrielle"), in Italy ("stile industria") and other countries.

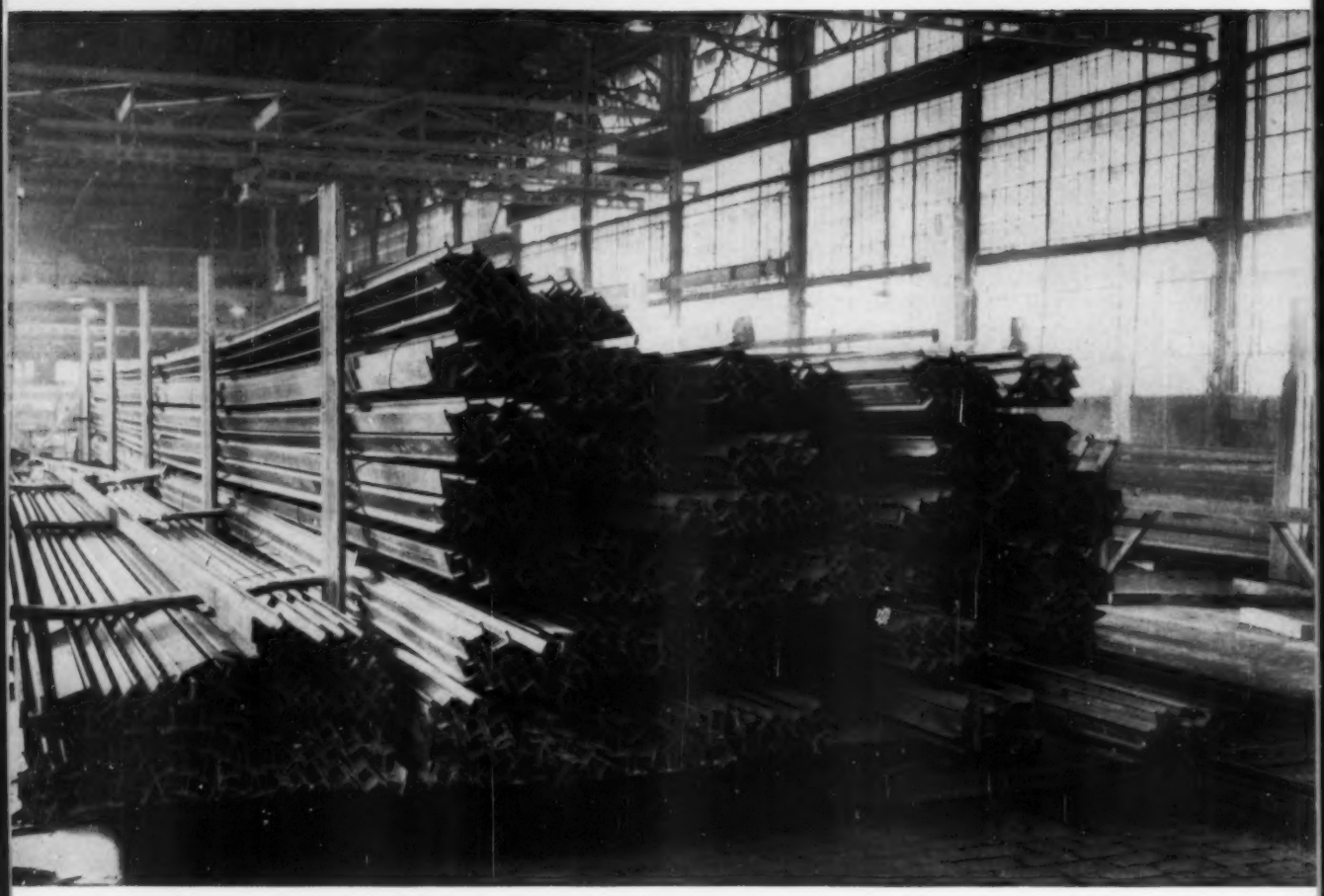
As always in such international gatherings of industrial designers, the question arose whether some sort of "international look" is developing in product design, at the expense of the indigenous expressions typical of the various national groups. I am convinced that no such international look is likely to take over.

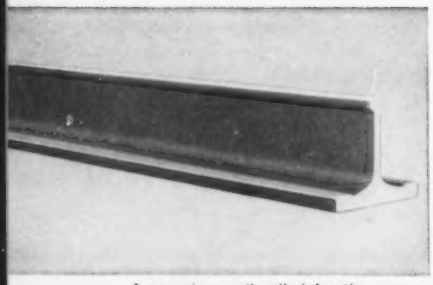
Even in America, where perhaps there is more of a tendency toward lookalikes in product design than anywhere else, we still find at least as many dissimilarities between Westinghouse and General Electric refrigerators as similarities. And if you asked a Scandinavian designer to undertake the design of such an appliance, I assure you he would retain fully his sculptural approach and painstaking attention to detail. The Scandinavian would also insist on, and be able to command, the exact finish (tolerances, edges, polish, color) he had specified.

Even with growing standardization, there is no reason to expect products of various nationalities to become completely indistinguishable. For example, Medieval Europe painted Madonnas for centuries. To a large extent, religious concepts dictated rigid limitations on composition and even color (frequently, the Madonna's garment had to be blue). Yet the Madonnas done by each nation's artists remained quite unlike those of other countries. At least as many national influences exist today, and are likely to prove decisive in retaining individual "national looks" in the manufactured products of the future.

In fact, the kind of competition and other conditions likely to develop within the Common Market and the adjacent trading area known as the "Outer Seven" (Great Britain, Switzerland, Austria, Portugal, the Scandinavian countries), should help the character of each country's products to become even more clearly defined; yet there can still be an important place for American design and engineering—this great new mass market can and should become a vast new area of opportunity for US manufacturers. ■

STEEL SHAPED TO CUT COSTS AND IMPROVE PRODUCTS





A one-piece rail rolled for the runway of Cleveland Tramrail Systems. This track has flat raisnd treads designed to minimize peening. No machining is required on this USS Special Section.

USS

United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
United States Steel Export Company

United States Steel

Tramrail—non-peening, no machining made from USS Special Sections

This supply of rails for Cleveland Tramrail Systems represents a cost saving running into many thousands of dollars. They are USS Special Sections rolled to exact size and cut to proper length. If the rails had to be machined from bars of high-carbon or alloy steel, the cost would be prohibitive and scrap losses tremendous.

The steel is furnished in a high carbon grade which serves to minimize track wear caused by wheel peening on the track tread. The manufacturer says that in 30 years no other overhead track has been offered that surpasses this one for durability.

It's seldom that better products can be produced at substantially lower costs but that's what happens when you use rolled USS Special Sections. Rolled to the predominating cross section needed, it is a custom-tailored part, designed and rolled so that there is little or no finishing required to meet final specifications.

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USS is a registered trademark

the 9th step to better engineering writing

Our recent series of writing lessons brought a sprinkling of brickbats amid the shower of requests for extra copies. We are much chastened, as you will see below.

RICHARD M KOFF, *senior associate editor*

■ Careful, careful. Each word must be weighed and measured, each construction examined from all angles, each sentence read and reread by trained editors. But we goofed anyway, as sharp-eyed readers of our "8 Steps to Better Engineering Writing" series were quick to point out.

So here are their comments. Some refer to clearcut and indefensible errors. Others are less certain and we discuss them a bit.

Lesson . . 3 (Sep 21 p 29)

One sentence was so bad it still makes us blush. We wrote:

The man who writes for a larger public, even those who are engineers and scientists, know better.

A high school senior was quick to note that the verb (*know*) should agree with the subject (*man*). We caught the error in the reprinted series and made the sentence:

The man who writes for a larger public, even those who are engineers and scientists, knows better.

But this is wrong too! The parenthetical phrase ("even . . . scientists") should also agree with the subject. Correctly, then, the sentence would be:

Men who write for a larger public, even those who are engineers and scientists, know better.

Lesson . . 5 (Oct 5 p 47)

A reader writes, "May I take issue with your stand on the split infinitive . . . you indicate that split infinitives are bad usage. This is incorrect . . . most college English teachers accept them as perfectly good usage."

Not to reopen an old debate, we still feel (as do most editors and grammarians—see the references at the end of Lesson 8) that the split infinitive is undesirable and to be avoided except when absolutely necessary .

In this same lesson we wrote, "Don't try to write 'down' to a serviceman in a manual . . ." An experienced technical writer says, "Unless you write to his level . . . you will not get the message across." Quite true, and a professional writer must be very sensitive to the needs of his reader. But if an engineer tries to write in the vernacular of servicemen, or if his descriptions are condescending, he will irritate the reader far more than if he is natural—even if over their heads sometimes.

Lesson . . 7 (Oct 9 p 43)

"It upset me a great deal to see apostrophes used incorrectly."

We wrote, "why's and wherefore's"; should have written, "whys and wherefores."

Apostrophes are for possessive rather than plural forms, but certain plurals can cause trouble. You would mind your p's and q's (not ps and qs).

Lesson . . 8 (Oct 26 p 43)

The sample paragraphs containing 24 errors actually had several we overlooked. The second sentence was corrected to read, "Since the elements . . ." Should it have been, "Because the elements . . ."?

Our reference (Perrin's *Writer's Guide and Index to English*) says, "*Since* and *as* can be used in such clauses, but they are less definite, more casual, and more characteristic of easy speech than of writing."

Sentence four reads ". . . to solve a complex algebraic function." You may solve an equation or evaluate a function. You can't solve a function.

The last sentence reads, "By changing the lengths of the four links, an infinite number of speeds and paths are possible . . ."

The participial phrase opening this sentence is a dangler. The subject of the sentence (*number*) should be the subject of the phrase (*you*).

In this same sentence, should the verb (*are*) be singular rather than plural to agree with the subject (*number*)? Perrin says, "When a writer means the group as a whole, a collective noun takes a singular verb and singular pronoun; when he means the individuals of the group, the noun takes a plural verb or plural pronoun."

In this case the verb should be plural. But a complete rewrite of the sentence might be more to the point.

And last, here's a letter both angry and sad. Our question is, can it possibly be representative?

To the Editor:

About your series of articles on "How to Write." It's getting so I can't pick up an engineering or technical magazine without thinking I've gotten hold of a textbook on freshman English—Phooey!

Didn't your article writers go to school? Don't they realize that the average engineer has had to write short, terse, dynamic, interesting essays for several years, in grade school, then for four years of high-school English has written short, terse, dynamic, interesting essays and then for two or three years in college English courses has had to turn in short, terse, dynamic, interesting essays? When, as a newly graduated engineer, I wrote up my first short, terse, dynamic, interesting engineering report, my boss, a kindly man, merely blue-penciled all the terse, dynamic, verbs and wrote in the acceptable passive verbs such as "was done," "was performed," "would be appreciated," etc.

In short, you can write tersely and use the first person in intracompany memos, but readability cannot be tolerated in writing that goes to the customer (and especially so when your customer is the US Government!).

PS—Better withhold my name if you are rash enough to print this. I have enough troubles!

POINTS OF

THE QUESTION:

Engineers vs Draftsmen?

In "Perspectives," Aug 3, p 35, Maynard E. Creed, senior instructor at the New Hampshire Technical Institute, told PRODUCT ENGINEERING that "engineering has all the glory, and until drafting is recognized as an end in itself . . . the best young draftsmen will leave the field at the first opportunity . . ." Mr Creed went on to say, "If drafting is a language, as we are assured, it must be made an effective, stable and standard means of communication by those who are devoted solely to that end . . . The country badly needs a single drafting standard. But we don't need any new ones . . . Either American standards or military standards could be successfully applied on a national basis."

We have received several interesting comments discussing the above point of view. These are published below with Mr Creed's rebuttal.

As a draftsman . . .

I read Mr Creed's statements, as did several others in my office, and we agreed that his viewpoint is most gratifying. Most of us have experienced all of the unpleasantries mentioned, and we have all felt the frustration of being unable to correct the wrongs imposed upon the "classless" man.

On the subject of status, the most irritating rub is that we draftsmen have no status at all. We are not recognized as professional men; we are not tradesmen. We are not businessmen or laborers. What, then, are we? In our own circles, we refer to ourselves sardonically as "dumb draftsmen." This, perhaps, is a reaction from the days when many of us were enlisted men during War II, and were treated as such. In most engineering offices, the case remains much the same, with the college graduate recognized as the officer, and the draftsman as the dogface.

On the strength of my experience and know-how, I find myself doing all the plumbing design and layout for our pulp and paper mills, and laying out all the sewers and much of the process piping. I also do the mill-layout maps and other incidental work. My salary is quite good; $660 per month at present.

But I have never yet been allowed a field trip to inspect my work, nor am I ever consulted on decisions pertaining to the work. Nor do any of the other draftsmen enjoy such considerations.

However, young graduate engineers, new to the office, are lavishly treated to airline trips to the various mills, and are given other privileges denied to draftsmen. I feel that if I design a piping layout, and make the drawing, I should be entitled to see the thing work. When changes are made on my work, I am given the details second or third hand, whereas if I could check the work myself, I could do a much better job, and much quicker.

The idea of a Society of Professional Draftsmen has been on my mind for many years. Undoubtedly, others have toyed with the idea but, as far as I know, nothing has been done to create such an organization. During some of my more bitter moments, I've considered a draftsmen's union. There are a number of these groups around, but some seem to be functioning for the benefit of a few dues collectors and career racketeers.

A professional man differs from the tradesman, perhaps, in the fact that he is never through learning. He is always contending with new and different situations, and is solving new and different problems. He always has a new obstacle to hurdle, and he frequently deals with intangibles. A tradesman learns his job pretty well in three or four years, and it isn't long before he has run up against just about every problem his work can present. This is not so with a professional, and it isn't the case with the draftsman. As a draftsman, I certainly don't know it all yet, and I don't think I ever will. Each job and each drawing is a new challenge to my experience and ingenuity.

I want to see a draftsmen's organization in this country, and I would like to devote some of my time and efforts toward getting the thing started here in Seattle. Perhaps you could make some suggestions. I would welcome some help.

In closing, I wish to thank you, in behalf of myself and all other draftsmen, for your thoughts in our direction. Frankly, we need a shot in the arm. You mention that many young draftsmen leave the field for other types of work. I say that I am now 39 years old, but I would leave the "trade" tomorrow if I could get a comparable income doing manual labor. I would then be able to draw strictly for pleasure, as I did before I embarked upon this "career."

—W B GRISVARD
Seattle, Wash

VIEW

I agree . . .

with Mr Creed that drafting is a language and should be a single standard of communication. I do not agree with him as to the way this should come about. Drafting is a form of communication between engineers and the people who translate engineering concepts into hardware. The draftsman is but a translator in this communications link. No translator should determine the language in which messages are received or transmitted. The languages are determined solely by the originating and terminating activity. The draftsman finds the fulfillment of his mission in translating the messages from the language of origin into the language and form for most efficient utilization by the termination.

I experienced the situation proposed by Mr Creed wherein the drafting department wrote its own standards. The draftsman welded a perfect communications link—but between draftsmen. It was not unusual for more effort to be expended in translating the messages from the draftsman into the form in which it would ultimately be used than was expended in doing the work called for in the message.

I submit that the way in which drafting should become a single-standard form of communication is for the originating and terminating activities to adopt a universal single-standard language. This would call for a meeting-of-the-minds between engineering and technical activities. This should not be too difficult, for the technical activities exist for the support of engineering activities. It therefore follows that engineers are the ones who should write the language to be used, not draftsmen.

If Mr Creed thinks draftsmen are deserving of professional recognition, I ask him to consider their role in the communications link. If the single-standard language we all desire ever became reality, the most unnecessary component in the link would be a translator (draftsman), whereas the technician, presently considered the lowest form of life on the payroll, would still be indispensable. If Mr Creed doubts this, refer him to the new techniques for making schematics by composition (GE–Fotosetter). It is not inconceivable that draftsmen will be replaced by more efficient breeds trained in keyboard operations. If this should occur, typing instructors the country over will probably demand professional recognition for their charges as Mr Creed has for his.

—BILL SMITH
Geophysical Laboratory
Continental Oil

To answer Mr Smith's objections . . .

I will "specify" (in the legal sense) that there is something to be desired of drafting, and of draftsmen as they are now trained. That done, let us examine the setup under which this occurs. Drafting texts are engineer-written, engineers and the majority of draftsmen are taught by engineers, drafting rooms are for the most part under the direct supervision of engineers, and the over-all custodianship of the language is in the hands of engineers. If there is anything wrong with drafting and draftsmen we must look to engineering for an explanation.

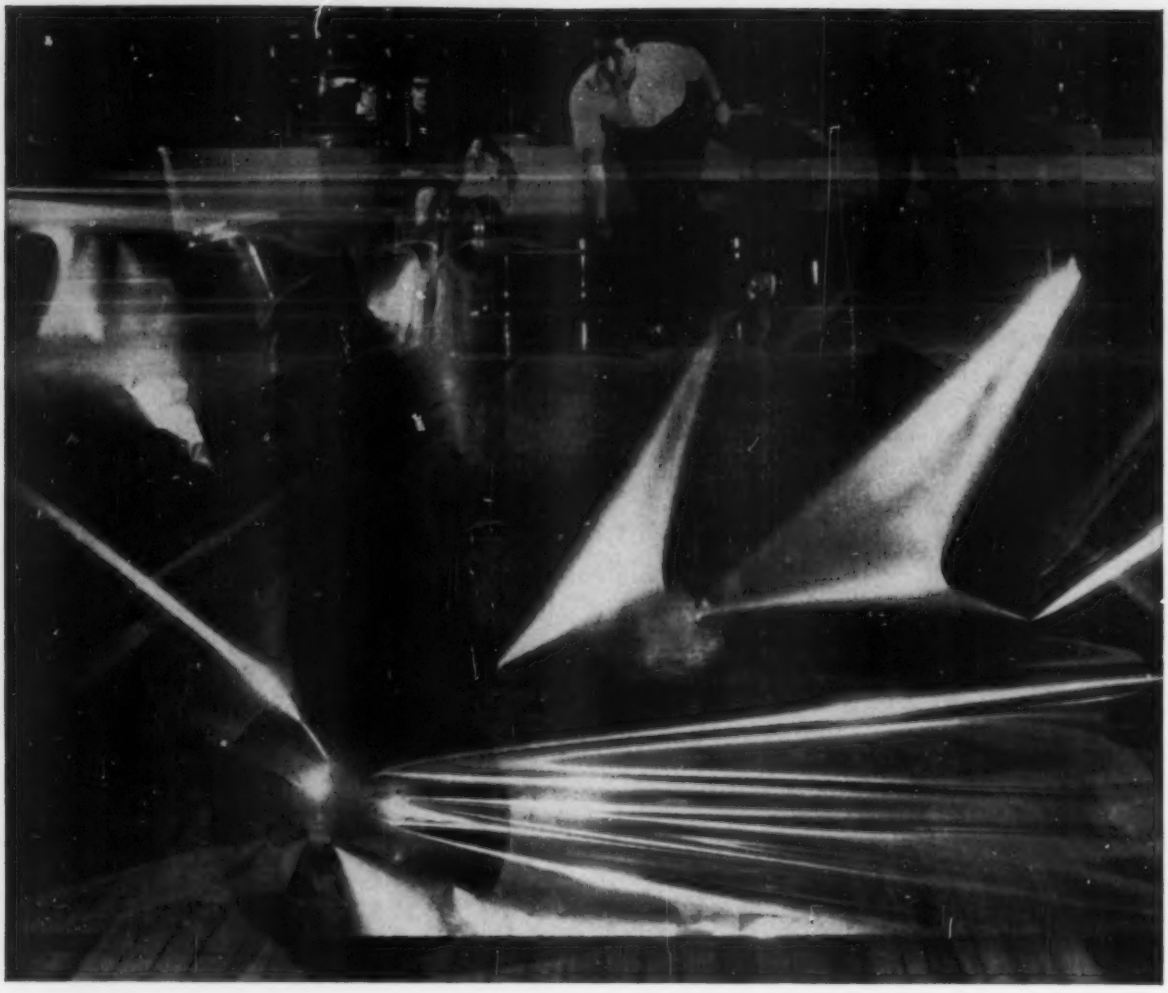
I hold no brief for drafting as presently constituted but I insist that efficiency demands that draftsmen be trained as language specialists and not as stop-gap men on the way to the prestige positions so loosely, and often inaccurately, called this or that engineer. I know of no language that confers expert or supervisory status upon the completion of 180 hours of study or (as I understand one engineering college schedules) nine credit hours.

I agree with Mr Smith that the *matter* to be translated into drafting is the province of engineering. Similarly with the author of a book. But because the author is the principal user of the language and the communicator of ideas does not make him the logical displacer of the editor or the lexicographer.

Mr Smith submits that in his experience draftsmen cannot efficiently write their own standards. I am not at all surprised that he has found this true under the present system.

Like most draftsmen, and I am a draftsman, I am fully aware of all the latest "crutches." I approve of them as timesavers but the best of them require men for their use, and the better the man the faster the job. In the same vein, may I remind Mr Smith that, with the advances being made in computer design, a time may come when the specifications for a needed piece of hardware will be fed to a computer/designer/engineer to bypass not only the draftsman but certainly a large number of engineers.

—MAYNARD E CREED
Senior instructor
New Hampshire Technical Institute
Portsmouth, NH



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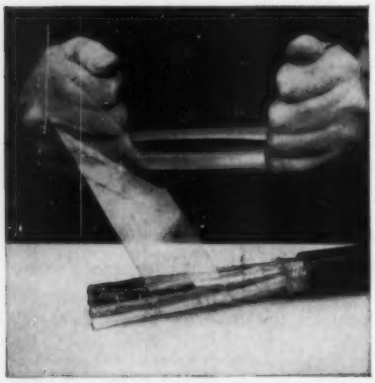

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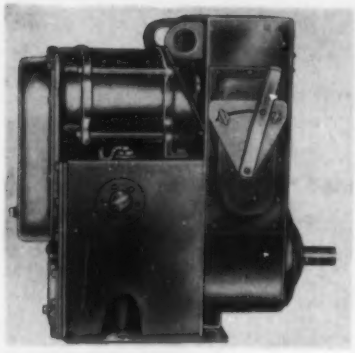

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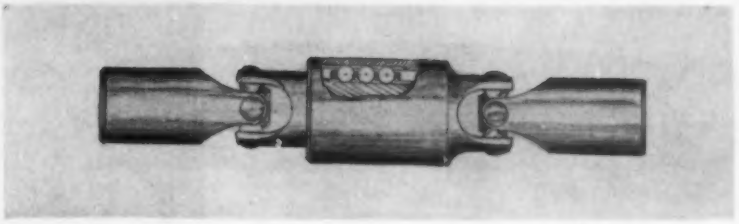

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for precise transmission of data consists of two preloaded ball splines sealed with lubricant in a slip joint. Backlash is said to be zero for entire assembly, which is made of stainless steels. Following are standard assemblies and all have ¼-in. lateral travel: ⅜ in. body with ⅛ or ¼ in. bores; ⅝ in. body with ⅜ in. bore; ¾ in. body with ½ in. bore. Torque ratings are 16, 64 and 256 in.-oz, respectively. Price, $19.50 each in quantities of 10. Available from stock. **Falcon Machine & Tool Co, 209 Concord Turnpike, Cambridge, Mass.**

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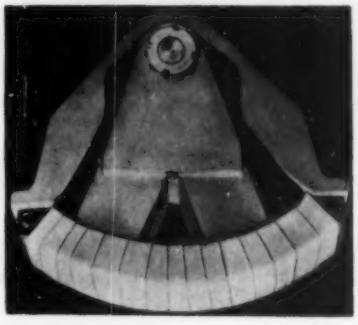

Dc torque motor . . .

provides rotary motion up to 60° with infinite resolution—better than 1% linearity of torque vs input current according to manufacturer. Available in sizes with torque ratings to 200 in.-lb, rotational limits up to 60°. $200 to $900, depending on type and quantity; 30-60 day delivery. **Aeroflex Corp, 3406 Skillman Ave, Long Island City 1, NY.**

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10-tube tapes of vinyl . . .

for use in low-pressure fluid distribution, instrumentation and electronic harness applications are made both clear and color-coded. Individual tubes can be readily stripped from others for all or part of length (up to 100 ft). Available in 12 stock sizes, ranging from 1/32 to ¼ in. ID. 17½ to 30¢ per ft for up to 500 ft. 1-wk delivery. **Jessall Plastics, Div Electric Storage Battery Co, Kensington, Conn.**

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permits infinite adjustment of air flow. Compared to centrifugal compressor of same rating, 125,000 cfm axial unit would be about half diameter and a quarter of weight. **Allis-Chalmers Mfg Co, Milwaukee 1.**

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cylinder maintain flow in hopper or storage bin by applying vibrations directly to dry materials themselves, rather than to containing structure. Vibrating shaft-and-spider assembly is moved up and down slowly about 1 ft when blockage occurs. Can handle materials at rates of 1 oz to 100 ton per hr. Price, $300 to $1500 per installation. **Vibra Screw Feeders Inc, 156 Huron Ave, Clifton, NJ.**

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for transistor and diode protection in various types of circuitry is for use in applications involving 1/8 to 1 amp (depending on model used). Said to act 300 to 400% faster than related devices, limiter is single-use device available in ratings from 1/32 to 5 amp in two configurations: to fit a standard fuse holder, pigtail type for printed circuits. Price ranges from $3.20 to $1.85, depending on model and quantity. Delivery, from stock in sample quantities. **Microelectron, Inc, P O Box 24174, Los Angeles 24.**

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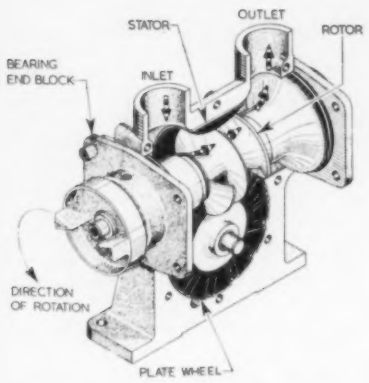

Positive displacement pump . .

handles 72 to 3800 gph, depending on unit size and operating head. Rotor based on Archimedean screw engages slots in rotating rubber-covered plate, providing axial flow that is said to be pulseless over wide speed range (1000 to 3500 rpm). Made in England. **Goodyear Pumps, Inc, 9 Rockefeller Plaza, New York 20.**

Circle 109 on Reader Service Card

Flow control valves . . .

can be adjusted from almost zero to full flow in restricted direction, with full flow at negligible pressure drop in free flow direction. Valve has aluminum body with stainless piston and is available from stock in $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$ and $\frac{3}{4}$ in. female pipe size. **Ficon Industries Inc, PO Box 986, Santa Monica, Calif.**

Circle 110 on Reader Service Card

Rectilinear transducer . . .

is of ac electromechanical bridge design based on variable permeance and is made in five models which range from 2 to $9\frac{1}{2}$ in. length. Operation on 24 v rms max is recommended. Output is approximately $\frac{3}{4}$ of input for full stroke displacement over rated range. **Crescent Engineering & Research Co, 5442-N N Peck Rd, El Monte, Calif.**

Circle 111 on Reader Service Card

Enamel-coated aluminum sheet . . .

up to 60 in. wide and in thicknesses of 0.019 to 0.051 in. is available either one-side or two-side coated. Nineteen shades are available on a variety of alloys. **Aluminum Co of America, 1501 Alcoa Bldg, Pittsburgh 19.**

Circle 112 on Reader Service Card

Special WIRE CLOTH PARTS

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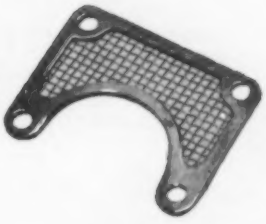

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Windings: compound, shunt, and series.

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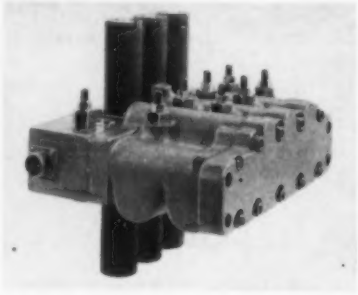
FREE BULLETIN — Write to Section 634-21, Schenectady, N. Y. — GENERAL ELECTRIC

SIGNIFICANT COMPONENTS MATERIALS PROCESSES . . .

Subminiature time delay . . . devices include relay, switch and timing modules. Relay provides range of 0.05 to 90 sec. Contacts are SPDT, 0.25 amp at 28 v resistive. Switch has no moving parts and closes after delay period elapses. Delay range is 0.05 to 180 sec. Contacts are SPST, 5 amp up to 20 v dc at 77 F. Timer is designed to operate solid-state or mechanical relays, 0.05 to 180 sec. Accuracy of all units, ± 5%. **Hydro-Aire Co. 3000 Winona Ave. Burbank. Calif.**

Circle 113 on Reader Service Card



Hydraulic valve for mobile . . . equipment is controlled electrically by oil-immersed, dc solenoids available in all standard voltages or ac solenoids pre-wired to plug-in connectors. For pressures to 2000 psi, and with nominal rating of 15 gpm, offered in three-spool model. **Double A Products Co, sub Brown & Sharpe Mfg Co, Manchester, Mich.**

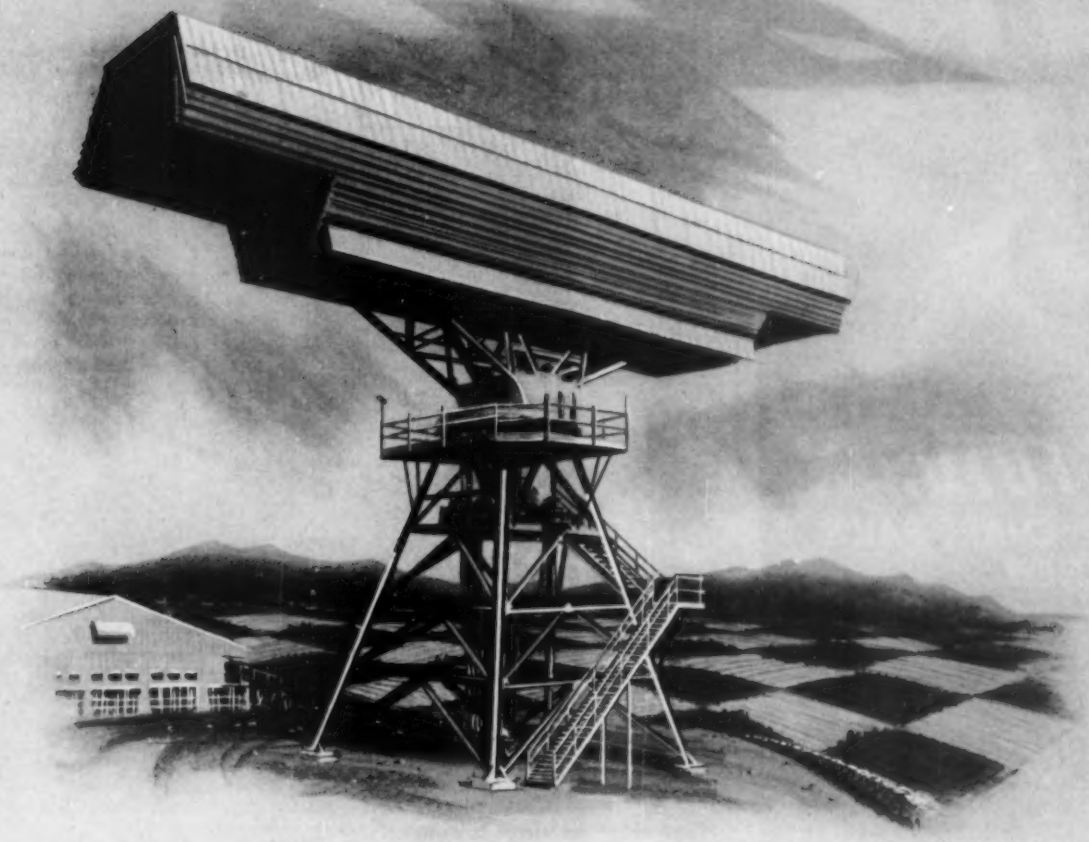
Circle 114 on Reader Service Card

Linear variable transducer . . . based on differential transformer is available in six models with ½ in. dia and lengths of 1½ to 17 in., and input voltages of 6.3 to 24 v. Temperature range, −100 F to 350 F. Sensitivity specified as millivolt output per 0.001 in. displacement. **Pacific Electrokinetics, 329 S Vermont Ave, Glendora, Calif.**

Circle 115 on Reader Service Card

Proximity sensing device . . . detects both metal and non-metallic objects as they enter a capacity field. Consists of sensing element or probe connected by co-axial cable to electronic unit. Can be set to sense whether objects are present, absent, too large or too small, or too far or near a set point. Can be used to adjust or stop machine or trip alarm. **Security Controls, Inc, 503 Franklin St, Buffalo 2.**

Circle 116 on Reader Service Card



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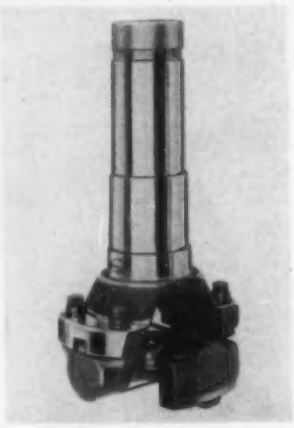

Universal joint . . .

for drive applications on trucks and off-highway equipment is said to provide 39,000 in.-lb torque, with swing dia of 6 in. **Rockwell-Standard Corp, Allegan, Mich.**

Circle 117 on Reader Service Card

Heat-reactive vinyl tubing . . .

contracts at temperatures over 275 F to form skin-tight armor or insulation over rods, tubes or shapes. Available in 25 standard sizes to cover $\frac{3}{64}$ to 5 in. dia. **Dept E9-480, Minnesota Mining & Mfg Co, 900 Bush Ave, St. Paul 6.**

Circle 118 on Reader Service Card

Plastic structural shapes . . .

for scale models have been added to original line of scale pipe and fittings. Stock shapes, made of steel gray impact polystyrene, are available in I's, H's, angles, channels and tees, in sizes from $\frac{1}{8}$ to $1\frac{1}{4}$ in. **Industrial Models Inc, 2311 Sconset Rd, Wilmington 3, Del.**

Circle 119 on Reader Service Card

Dual-element strain gage . . .

is temperature compensated for bonding to any one of a variety of materials; previously such gages were available compensated for temperature change only for use with one specific material. Compensation extends from −350 F to 850 F. Simple external circuit permits adjustment of temperature response characteristics of gage to any material within specified limits. Gage is designed with platinum wire compensating element contained within boundaries of prestabilized Nichrome foil sensing grid. Depending on type ordered, price is $75 to $100 per package of five gages; immediate delivery. **Baldwin-Lima-Hamilton Corp, 42 Fourth Ave, Waltham 54, Mass.**

Circle 120 on Reader Service Card

Proximity transducer . . .

measures small mechanical displacements from zero to 20,000 cps. Micrometer head is calibrated directly in 0.0001 in. Output is for display on oscilloscope, where any point on trace can be measured in reference to any other point. **Photocon Research Products, 421 N Altadena Dr, Pasadena, Calif.**

Circle 121 on Reader Service Card

Displacement, force, load or . .

pressure may be measured with English-made portable multimeter that consists of measuring bridge with assorted transducers. May also be used with cathode ray oscilloscope of various types. Ranges: for displacement, 0.12 to 0.003 in; pressure, 0 to 5000 psi; load, 0 to 10,000 lb. Accuracy is said to be ± 3% on all ranges. Supply required, 200-250 v ac, 50 cps; built-in energizing supply, 5 v; output, ± 0.15 ma dc into 1500 ohm load. Weighs 22 lb; 15 x 9 x 6 in. deep. **Telechrome Mfg Corp, 28 Ranick Drive, Amityville, NY.**

Circle 122 on Reader Service Card

Flush-fitting legend . . .

light assembly can be mounted side-by-side in tandem or stacked. Contains two MS 327 lamps, available in different colors and is offered $1\frac{1}{2}$ x 9.375, $1\frac{11}{16}$ x 0.425, $2\frac{1}{8}$ x 0.375 in. **Radar Relay, Inc, 2322 Michigan Ave, Santa Monica, Calif.**

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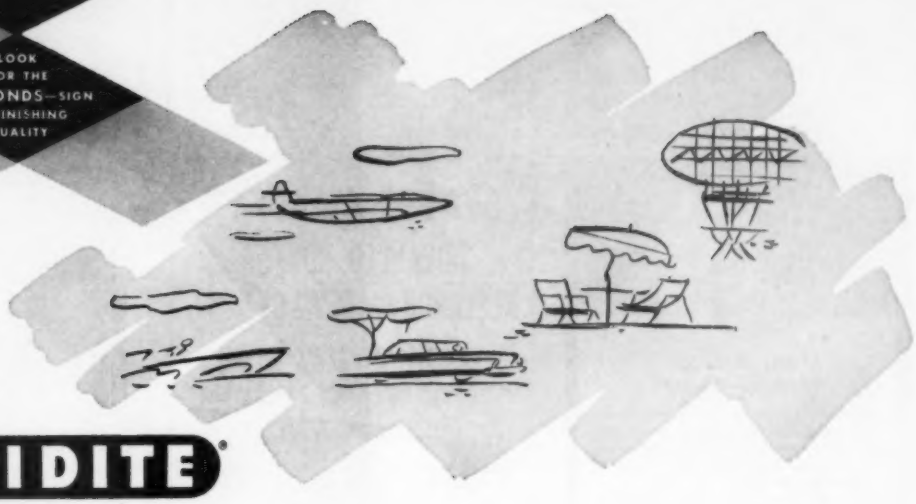

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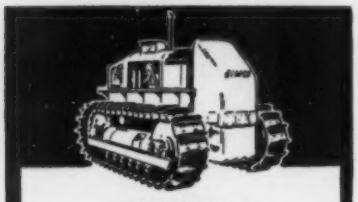

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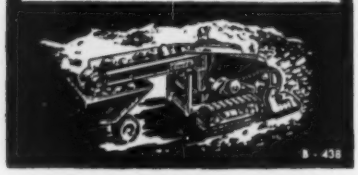

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MIDLAND-ROSE CORP. Owosso, Mich.

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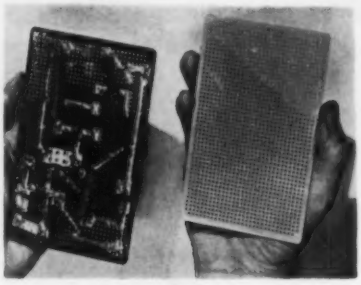

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is clad on both sides with copper that can be etched away to obtain developmental circuitry of various types. Grid consists of 0.052-in. round holes spaced $\frac{1}{10}$ in. on centers. Boards are $\frac{1}{16}$ in. thick and are available in three sizes: 3 x 5 in., 6 x 8 in., 9 x 12 in. **Corning Glass Works, Bradford, Penna.**

Circle 124 on Reader Service Card

Monofilament strain gage . . .

has single, straight, strain-sensitive element, with suitable leads attached, and is coated with electrically-insulating cement. Total diameter is less than 0.012 in. Coating permits use with non-insulating cements and cements that cure at low temperatures. Wire device configuration is applicable to inaccessible locations, such as insertion into structural fasteners where it would respond to axial loads only; fit into narrow sections such as ligaments in tube sheets and headers, small tubes and rods; in honeycomb and corrugated structures; cast directly into plastics or low-melting metals; and in weld puddles to determine strain induced in cooling. Gage is available in various materials, configurations, and electrical resistances of 60, 120 and 240 ohm. Can withstand up to 2000 F. **High Temperature Instruments Corp, Bala-Cynwyd, Penna.**

Circle 125 on Reader Service Card

Motor-tach-generator . . .

is size 8 precision unit for —67 to 257 F operation. Made from corrosion-resistant materials, unit meets military environmental specifications. Rotor moment of inertia is 0.65. Continuous-duty motor has 0.2 in.-oz min stall torque with about 5 w total input, 600 rpm speed at no load, 26 v (fixed phase) and 40 v (control phase) rated voltage. Tachometer-generator has 26 v rms, 400 cps rated input voltage and 0.26 v rms output at 1000 rpm. **John Oster Mfg Co, Avionic Div, 1 Main St, Racine, Wis.**

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NEW LITERATURE

Three on Patent Procedures

Engineers have frequent opportunities to become inventors. But when urged by their company, friends—or wife—to put their ideas down on paper in a form suitable for a patent application they often do not have the faintest idea what is involved, and what is expected of them. They are not sure what constitutes patentability, and are frightened by the possibility of a court case.

The three recent books reviewed below show how to develop ideas, protect new products and processes, profit from proper patent management:

Patents & Inventions, *Superintendent of Documents, US Government Printing Office, Washington 25, DC. 6 x 9 (paperback), 25 pp. 25¢.*

This pamphlet summarizes the basic steps in applying for a patent, and gives a list of answers to questions frequently asked on this subject.

FORREST E. GILMORE. **How To Invent.** *Gulf Publishing Co, Houston, Tex. 4¼ x 6, 89 pp. $2.50.*

This book shows engineers and scientists how to increase their creativity. It tells how to: use intuition and imagination, prepare for invention, set the stage for illumination and inspiration, when and where to invent, why one should learn to invent, what rewards can be reaped from inventing. The reader will find that learning how to invent can be an interesting and profitable occupation—even if it never leads to a patentable invention.

ALF K BERLE and L. SPRAGUE DE CAMP. **Inventions, Patents and their Management.** *Van Nostrand, 120 Alexander St, Princeton, NJ. 5⅜ x 8⅜, 616 pp. $12.50.*

This book discusses 44 actual, lucid cases that show the reader how to develop an idea into an invention, a good patent, a good product, a business, a return on investment.

The authors discuss principles and procedures that apply to working with patents in all fields of technology (electrical, mechanical, chemical, nuclear) from hearing aids, can openers and meters to trains, from printing presses, welders to solid fuels.

Although nontechnical in approach, this book attempts to teach the language of the business of inventing as used by attorneys, engineers and executives working extensively in this field. By giving a logical grasp of legal, technical and commercial terms having to do with the subject, it enables the inventor to understand the people he must work with and to make himself understood by them. —NC

INDEPENDENT RESEARCHERS — Brochure, 4 pp. Cites advantages of using outside independent research teams to help develop company programs. Manhattan Physical Research Group Inc, 556 W 191st St, New York 40.

Circle 140 on Reader Service Card

SPECIAL ALLOYS—Data bulletins 501 through 507. General characteristics, physical constants, heat treatment and properties of special alloys. Other bulletins cover metals processing services offered. Precision Metals Div, Hamilton Watch Co, Lancaster, Penna.

Circle 141 on Reader Service Card

RELIABILITY TESTS—Booklet, 4 pp. Describes range of reliability tests available. Magnaflux Corp, 7300 W Lawrence Ave, Chicago 31.

Circle 142 on Reader Service Card

ALLOYS WITH HIGH CORROSION RESISTANCE—Bulletin, 6 pp. Outlines applications of Hastelloy Alloys B and C, and describes their resistance to corrosive fluids at specified concentrations and temperatures. Also covers size ranges and tolerances of pipe and tubing available in these alloys. Carpenter Steel Co, Alloy Tube Div, Union, NJ.

Circle 143 on Reader Service Card

Letterhead Requests Only

Manufacturers who published following literature asked that requests for copies be made on company letterheads.

SYSTEMS APPROACH TO ELECTRONIC WIRING AND CONNECTIONS—Booklet, 24 pp. Divided into three parts covering: case histories on printed-circuit and wiring-device applications, designed to stimulate new application ideas; check lists to assist in specifying, designing and integrating multiple wiring device components; and design, tooling, manufacturing and inspection facilities. Methode Mfg Corp, 7447 W Wilson Ave, Chicago 31.

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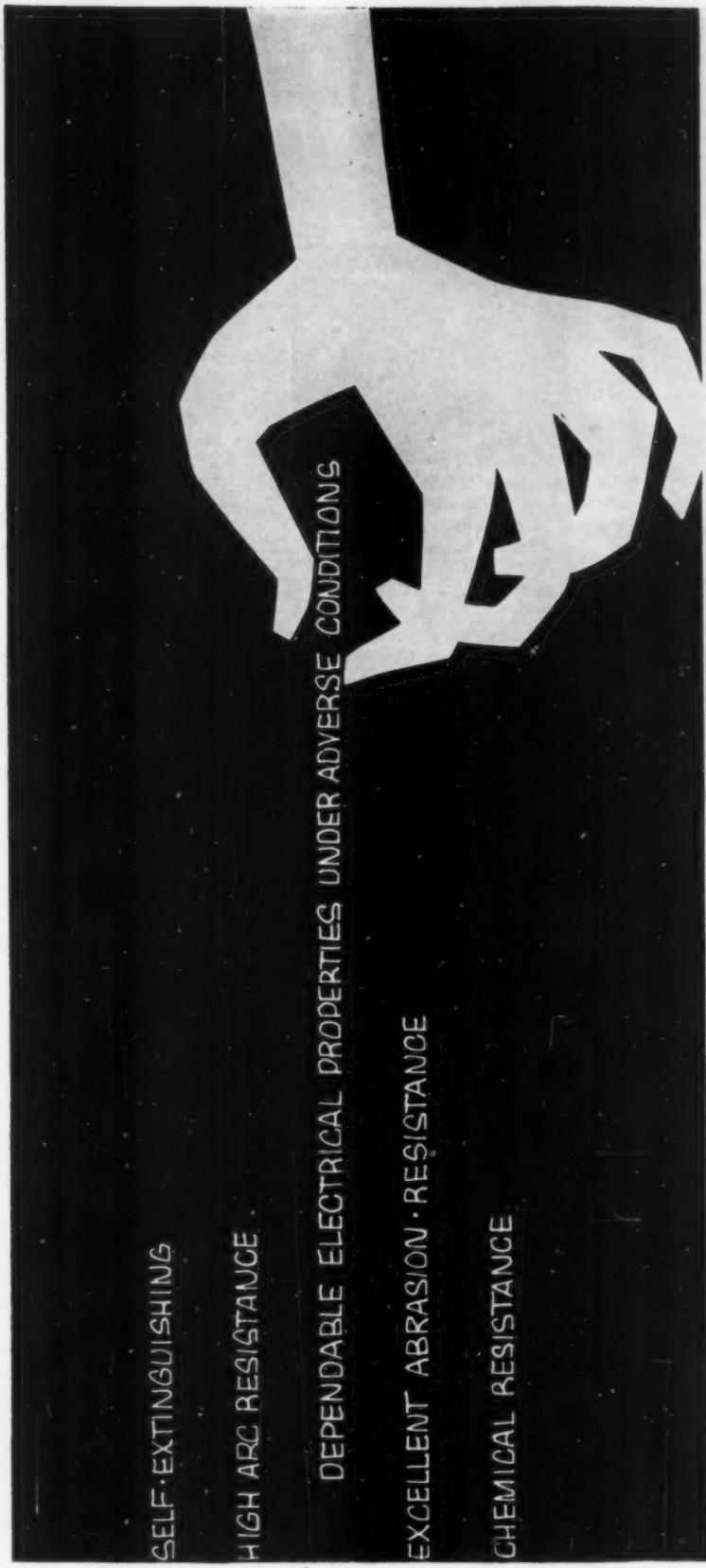
San Francisco 4 . . . W. C. Woolston, 68 Post St., Douglas 2-4600



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CYMEL 3135–3136 (glass-filled) Additional distinctive properties: outstanding electrical properties; high impact resistance; extraordinary flame resistance; good dimensional stability. Typical applications: circuit breaker boxes; terminal strips; connectors; coil forms; stand-off insulators. Specifications: Cymel 3135 (MMI-30, MIL-M-14E, Federal L-M-181 Type 8; ASTM D704-55T Type 8); Cymel 3136 (MIL-M-19061, MMI-5).

CYMEL 592 (asbestos-filled) Additional distinctive properties: resistance to atmospheric extremes; high dielectric strength. Typical applications: connector plugs; terminal blocks; a/c, automotive and heavy duty industrial ignition parts. Specifications: MIL-M-14E MME; Federal L-M-181 Type 2; ASTM D704-55T Type 2, SP1 SPEC NO. 27025.

CYMEL 1077 (alpha cellulose-filled) Additional distinctive properties: Surface hardness, heat resistance, unlimited color range. Typical applications: appliance housings, shaver housings, business machine keys. Specifications: MIL-M-14E – Type CMG (in approved colors); Federal L-M-181 Type 1; ASTM D704-55T Type 1, SP1 SPEC NO. 30026.

CYMEL 1500 (wood flour-filled)–CYMEL 1502 (alpha cellulose-filled) Additional distinctive properties: Good insert retention. Typical applications: meter blocks, ignition parts, terminal strips. Specifications: Cymel 1500 (MIL-M-14E Type CMG, Federal L-M-181 Type 6, ASTM D704-55T Type 6); Cymel 1502 (MIL-M-14E Type CMG, Federal L-M-181 Type 7; ASTM D704-55T Type 7.

BEETLE® UREA (alpha-filled) Additional distinctive properties: Economy of fabrication, economy of material, myriad translucent and opaque colors. Typical applications: wiring devices, home circuit breakers, tube bases, appliance housings. Specifications: Federal L-P-406A, LC 726-1, ASTM D705-55, Grade 1 (Arc resistance limits are in process of revision by ASTM), SP1 SPEC NO. 27026.

WRITE FOR COMPLETE TECHNICAL DATA.

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For Your Information (personal)

Linde stars march to market. These synthetic sapphires from Linde Co furnaces rival the natural in properties and appearance.

Which gem—man-made or mined?

Shall it be a little sapphire straight from the mine—or a giant star ruby straight from the lab? Shall it be a real diamond—or a sparkling strontium-titanate crystal such as nature never made?

The processes that provide rubies and emeralds for masers (*PE*—Aug 31, *p* 17) and sapphires for bearings and electron tube supports can also produce beautiful gem stones.

Today, the labs can duplicate almost every precious and semiprecious stone, and most at a fifth to a tenth the cost of the "genuine article."

In some cases, the labs outdo nature: man-made rubies can be bigger as well as much lower in cost than the largest ever mined. In other cases, the lab does not do quite as well. Man-made diamonds are still tiny and off-color—not suitable for gem use. Man-made star sapphires are every bit as beautiful as natural ones, but limited in size to about 30 carats (the largest found in nature run over 200 carats).

Synthetic rubies and sapphires are not simulated materials. In every chemical and physical respect save one they are identical with the natural stone—only way to tell the two apart is through the regularity and symmetry of the synthetic. In the synthetic, inclusions are round and smooth, star legs are more nearly even.

The diamond is a separate case. So far, even the "best" man-made diamonds are far from gem quality; and the diamond-like titania (often known by such names as "Kenya gem") and strontium titanate (Fabulite) differ from the diamond in physical as well as chemical properties.

They're like the real gem stones, though, in having industrial uses. Strontium titanate, for instance, is finding applications in infrared instrumentation and, in ceramic form, is under test for structural applications; titania, in its powder or ceramic form, is a familiar industrial material.

Incidentally, synthetics are judged, for pricing, on the same basis as natural stones. The most valuable star sapphires, for instance, are those with the highest dome, clearest blue color, and best-centered star.

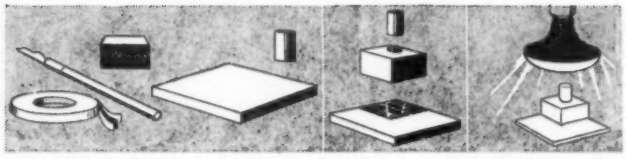
Computers are learning at last

A right smart little computer, no bigger than a brief case, and able to read ten *whole* words—zero through nine, spelled out—is being proudly displayed by Bell Labs scientists.

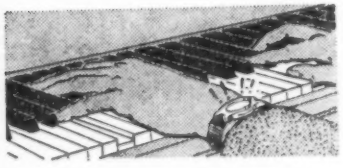
This computer is well beyond the ABC stage. It doesn't read letters one at a time, but words as a whole, by picking out features of the word's over-all shape—length, number and position of verticals, and so on.

It's a big advance, says BTL, over the previous units which could read only letter-by-letter and then only letters prepared in a rigid form (*PE*—Jan 20 '58, p 18). This one can recognize most people's handwriting if these three requirements are met: the words are written with a metal stylus on a special plate; the stylus is not lifted between letters; the "i's" are "dotted punctillously." —ARG

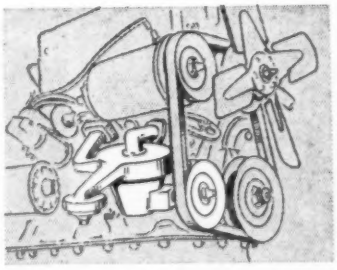
Why Don't They RESEARCH and DEVELOP . . .



. . . a double-coated pressure-sensitive tape with a heat-curable base material. The adhesive coating would give a temporary bond between two pieces of a model, mockup, plastic part, jig or similar small structure. While temporarily joined, the parts could be accurately positioned and adjusted. When all parts were in place, heat from a lamp or small furnace would melt and cure the base material to give a permanent bond. —J E GEARY



. . . a metronome that can be worn on the wrist like a watch. An escapement mechanism could be arranged to pulse a small wrist-thumping hammer at an adjustable rate. Rate could be controlled by the conventional watch stem and read from a dial which would look very much like an ordinary watch face. Or perhaps it could be powered by a battery and a condenser discharge. If successfully disguised as a wristwatch, it would be found useful to amateur musicians who are self-conscious about using a metronome. Doctors might find it helpful for getting a quick reading on pulse rate—just match the beats and read the dial. Or it could be used for timing prints in a darkroom or other places where it is too dark or too distracting to read an ordinary timer. —R MARIE



. . . a centrifugal oil filter for automobiles. Because most oil contaminants —dirt, metal particles, sludge, water—are heavier than the oil, they could be whirled to the outer edge and bled off as in a dairy's milk clarifier. An occasional shot of neutralizer (perhaps a small quantity every time oil is added) would keep the oil from becoming acidic. Centrifuge could be driven off the fan belt; pumping action would help boost flow of oil from the regular pump. —W SCOTT-MONCRIEF

Have you a problem, based on known scientific principles, which seems to have an answer somewhere within the limits of present technology? To inspire inventors along worthwhile paths, PRODUCT ENGINEERING invites you to trade such problems with fellow readers who may have a fresh viewpoint or more time for necessary R & D. We will pay $10 for each one accepted.

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Publisher's Postscript...

For your reference file

End-of-the-year chores are strange mixtures of pleasure and conscience. We buy Christmas presents, make good resolutions, and start the annual house cleaning—which never gets more than half done.

Similarly, in publishing we make our good resolutions by filling out all those little squares in the budget estimates and we clean house by clearing out the year's accumulations in files, storerooms and warehouses.

One such accumulation was brought to my attention this week and I think some of you may be interested. It seems that despite the extreme popularity of our Annual Design Digests, we still have 130 copies of the 5th Design Digest (1956), 150 copies of the 6th (1957) and 89 copies of the 7th (1958). When you consider that we have been publishing between 40,000 and 50,000 copies each year you realize what a small handful we have left.

The Digests include the most significant engineering data culled from a review of thousands of papers and articles published during the preceding year. This is extremely valuable reference material—much of it unavailable elsewhere in any form. So, on a first-come-first-served basis, we want to offer them to our readers, and here is the way we propose to do it.

We will give any one of the volumes free with a new subscription to PRODUCT ENGINEERING. You can get a second or third copy at $1 each. Naturally you will get the 1960 Design Digest as well, as part of your subscription, so this offer is an exceptionally good value.

If you wish to take advantage of this, simply write, on the Reader Service card on the other side of this page, which of the back issues of the Digest you want. Let us know if you prefer a one- ($5) or two-year subscription ($8). You will be billed later. —SJA

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Cartoonist Sid Hix looks at the expenses of buying "second best" motors.

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Are frequent motor breakdowns nullifying your product's other competitive advantages? Highest quality workmanship and materials make long life and service free operation inherent characteristics of all Bodine motors.

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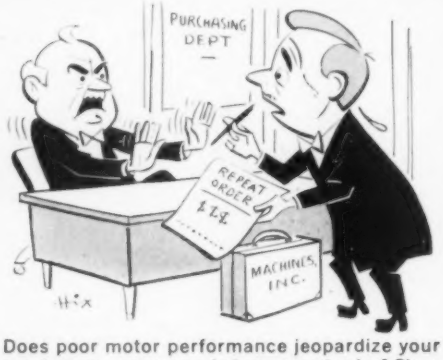

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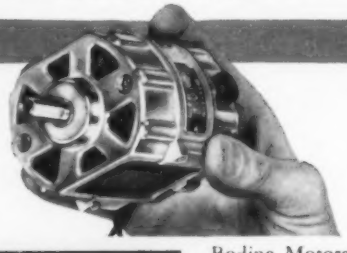

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